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THE TICK PROBLEM IN SOUTH AFRICA

By WILLIAM MOORE, *School of Agriculture, Pretoria*

One of the most important and interesting problems in Economic Entomology is the role played by ticks in the spread of certain diseases and how these ticks may be destroyed. There is probably no other country in the world where the tick problem assumes the proportion that it does in Africa. Most of the articles dealing with ticks which are available for the entomologist abroad do not consider the problem as it is presented to the entomologist and stock farmer in Africa. It is therefore—with the object of expressing the situation as it is in South Africa, that this paper is written.

Ticks and the Diseases Transmitted. In South Africa it is not one tick and one disease which must be dealt with, but a number of ticks producing a number of different diseases. *Boophilus decoloratus* Koch, the blue tick, carries Texas cattle fever (known in South Africa as redwater)—and *Spirochatosis*, the latter being a disease of cattle, horses and sheep. *Amblyomma hebraeum* Koch, the Bont tick, transmits a disease of sheep, goats and cattle, known as heartwater. The organism causing the heartwater has not yet been observed, and it therefore differs from the other diseases transmitted by ticks, which are caused by Protozoa. *Haemaphysalis leachi* Audouin, the dog tick, transmits the organism causing malignant jaundice, a rather fatal disease of dogs. *Rhipicephalus appendiculatus* Neumann, the brown tick, transmits East coast fever and gall-sickness of cattle, and may also transmit Texas cattle fever. *Rhipicephalus capensis* Koch, the Cape brown tick, transmits East coast fever. *Rhipicephalus simus* Koch, the black-pitted tick, and *Rhipicephalus evertsi* Neumann, the red tick, transmits East coast fever and gall-sickness, while *R. simus* may also transmit Spirochatosis, and *R. evertsi* is the carrier of biliary fever of horses.

Besides the ticks which are known to transmit diseases, there are many others which attack domesticated animals. Among these may be mentioned *Ixodes pilosus* Koch, which attacks sheep, goats, cattle, horses, etc., and is supposed to be the cause of a paralysis of sheep in Cape Colony; and *Hyalomma aegyptium* Linn., the Bont leg tick, the adult of which may be found on all domestic animals, and is thought by some to cause abscesses on the animals. Other ticks whose injuries may only amount to tick worry, are *Ixodes rubicundus* Neumann, *I. oculatus* Neumann, *R. sanguineus* (Lat.), *R. lunulatus* Neumann, *R. duttoni* Neumann, *R. bursa* Canestrini & Fanzago, *R. nitens* Neumann, *Amblyomma variegatum* (Fabr.), and sometimes *A. marmoreum* Koch.

The Life History of Certain Species. With this formidable array of ticks and diseases that they transmit, it can readily be seen that their destruction is not so simple as the control of *B. annulatus* is in the Southern United States. The problem is made more difficult by the fact that the life history of the various ticks differs considerably and in some cases is such, that destruction is impossible or next to impossible. Due to the work of Doctor Theiler, C. P. Lounsbury and C. W. Howard, the life cycle of many of the common ticks has been worked out. *B. decoloratus* has a very simple life cycle. In about five days or more from the time the engorged female drops from the host, the eggs are laid. These hatch in from three to six weeks or in winter a longer period is required. The larvæ may live for six or eight months without feeding. *B. decoloratus* seeks but one host in its life time, i.e. the moult from larva to nymph and from nymph to adult is performed without leaving the host animal. The period spent on the host is about three to four weeks. The eggs of *R. evertsi* hatch in about 30 days, and the larvæ can exist for seven months without feeding. *R. evertsi* differs from *B. decoloratus* in that two hosts are attacked in its life time. The moult from larva to nymph is performed upon the animal, but the engorged nymph drops from the animal and moults on the ground, seeking a second host for its adult existence. The time spent on the first host is about ten to fifteen days, but the adult tick may live for as much as a year, should it not find a suitable host. The adult tick remains on the host animal from six to ten days. The life cycle of *R. appendiculatus* is typical for *R. capensis, R. nitens,* and *R. simus* and is given for the group. The eggs are laid by the engorged female in about six or more days from the time she drops from the host animal. These hatch in from 28 days to several months, depending upon the temperature. The larva remains on the animal for about three to eight days, after which it too drops to the ground to moult—which is accomplished in a

days. The nymph attaches itself to a second host animal and remains for from two to seven days, when it drops off to moult to the adult. The second moult occupies about 18 days. The adult remains on the third host for a period of four to seven days. The larval tick can exist for seven months should it not find a host, the nymph six and one-half months, and the adult nine and one-half months. *A. hebraum* also has a life cycle much similar to *R. appendiculatus*. Three hosts are sought, the larva remains on the animal from four to 20 days, the nymph four to 20 days, and the adult 10 to 20 days.

H. aegyptium differs from the above species in that the larvae attach themselves to various birds and hares. The larva moults to the nymph while on the bird, but the engorged nymph drops to the ground to moult to the adult. The adult attacks domesticated animals being often very abundant upon oxen. *A. marmoreum* differs from *H. aegyptium* in that it is the larva or nymph which attacks oxen and goats, while the adult and also the nymph are very common upon tortoises.

"Trekking." Long before any relationship between ticks and disease had been discovered or even thought of, many of the Boers employed methods of ridding their flocks or herds of disease which were really based upon the distribution of the disease transmitting ticks. The High Veld is one of the farmers' favourite grazing sections of South Africa. The average altitude of the High Veld is between 4000 to 6000 feet. In the summer the land is covered with green grass, which makes very good grazing for cattle and sheep. Over this area the ticks which transmit diseases are limited or nearly limited to *R. evertsi* and *R. evertsi*. The reason for this is that the group of brown ticks and the Bont tick cannot withstand the temperature. In the winter the grass dries up and the pasture becomes poor, so the stock farmers started the practice of "trekking" or traveling with their animals to the warm low veld or bush veld, where the grass was abundant. There their animals often took sick from some of the "tick diseases"—especially was this true with the approach of the hot weather. The Boers would then trek back to the higher country, and upon reaching a place where the ticks which caused the disease could no longer live, the disease would disappear.

Grass Burning. Grass burning is another early method which was and is even yet often employed to reduce the number of ticks. By burning off the dry grass, the new green grass comes up much sooner and will furnish grazing for cattle and sheep at a much earlier date. Some farmers noticed that after the grass had thus been burned off the animals suffered far less from ticks. The practice of grass

burning then came to be adopted against the ticks themselves. Bu
ing off the grass, when the larvæ ticks are sitting on it waiting fo
host animal, will greatly reduce the number of ticks, but of cou
fails to destroy the ticks or tick eggs which are in a protected posi

Starvation of Ticks. The starvation method of eradicating ti
— which has been so successful in the Southern United States, agai
B. annulatus has been tried in South Africa, but has not been
effective. If *B. decoloratus* was the only tick which was to be starv
out, the method would prove successful in this country, providing
the host animals were kept off the land for a period of nine to t
months. The animals would all be moved into plot B and a

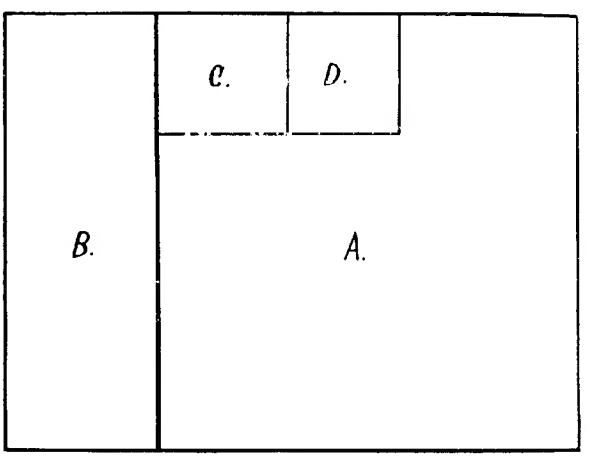

Fig. 6. Plan showing division of land for the starvation of ticks.

end of nine or ten months moved to plot C for a period of abo
five or six weeks, during which time all the ticks would have drop
from the animal, but they would not have time to lay their eggs, a
the larvæ of the next generation to attach themselves to the anim
The stock could then be turned into A which would be tick-free, wh
B and C could be closed to cattle for ten months.

Generally the question is not the eradication of the blue tick, b
also the eradication of the brown and red ticks, *Rhipicephalus* s
and the Bont tick *A. hebræum*. In theory even these could
destroyed by placing all the animals in B and keeping them th
for a period of fifteen months. They could then be transferred
C where they could be kept for about six weeks and the blue t

ould fall off, as stated above. From the facts given, however, it ll be seen that within four weeks the larvæ and nymphæ which ve dropped from the cattle when they were first moved into C will ve moulted to the succeeding stages and be again found on the ttle.

Therefore it is advisable to move the cattle at the end of 18 days to a new plot D so that the ticks which have dropped off in C will ot have had time to moult and again seek the host. In D the emainder of the ticks on the animals will drop off and in 18 days the animals tick-free could be turned into A. B, C, and D could be closed against cattle for 14 to 16 months and the farm thus freed of ticks. This method in theory would rid the farm of all the ticks which are known to transmit diseases to oxen, horses, sheep and goats.

In practice however the starvation of ticks is not so easy, due to the number of wild animals which will act as hosts to the ticks, thus carrying them over the starvation period.

The following table of the common ticks, which will attach themselves to some of the common wild animals, will show how easily the tick can be carried over the "starvation period":

COMMON AFRICAN TICKS AND THEIR WILD HOSTS

Hosts	*A. hebraeum*	*B. decoloratus*	*R. appendiculatus*	*R. capensis*	*R. evertsi*	*R. simus*
[illegible]	X	..	X			X
[illegible] Dog	X	..				X
[illegible]	..	..				X
[illegible] Buck		..			X	
[illegible] Antelopes	X		X		X	
[illegible]	X		X			
[illegible]	X				X	
[illegible] Pig	..					X
[illegible] Hare			X		X	
[illegible]	..					X
[illegible]	X					

This table compiled from the work of C. W. Howard, shows that of those ticks which transmit disease but two species do not find a host in the wild animals. In an actual trial of the starvation method carried out by H. E. Laws in the East London district, the results obtained very nearly what one would expect from the above. A portion a farm was closed to all stock in May 1908. In February, 1911, oxen were driven to the gate of the enclosed farm, and after all ticks which could be found were picked off, they were thoroughly sprayed with a mixture of kerosene and water containing 25 percent

of kerosene. The oxen were then turned into the paddock and allowed to remain for three days. The animals were then carefully examined and all the ticks collected, numbering 340 in all. The results may be conveniently tabulated.

TICKS COLLECTED FROM TEN OXEN

	Males	Females	Nymphs
A. hebræum	6		1
Ixodes pilosus	2	9	
R. simus	73	176	1
R. evertsi	8	3	
R. appendiculatus	27	15	2
R. capensis	5	8	
Hæmaphysalis parmata (?)		4	

From this experiment it will be seen that the blue tick can be starved, but it also shows that *R. capensis* seems to have some host among wild animals which has not been observed. Mr. Laws does not state what wild animals may have been running on this area other than hares and duiker (one of the antelopes)—both of which he mentions as being tick infested when shot.

Not all farmers have all the animals mentioned above, but hares and antelopes are very abundant. Many farms have hundreds or thousands of various antelopes which are not free to be shot even should the farmers so desire. With these conditions it does not seem likely that even the ticks which transmit diseases will be eradicated by the starvation method. *Hæmaphysalis leachi*, the tick which carries malignant jaundice, will probably never be eradicated, as dogs cannot be so readily handled as stock, while ticks such as *Hyalomma ægyptium* cannot be reduced to any great extent, as the birds will be constantly reinfesting the farm.

In favour of the starvation method, Dr. Theiler mentions that the freeing of an area from East coast fever is probably due to the starving out of the ticks. He does not mention that the ticks entirely disappeared, but that the area was freed from East coast fever by the removal of the stock for about 15 months. Inasmuch as the organism causing East coast fever does not remain in the blood of the recovered animal, and as the tick cannot transmit the disease after it has attached itself to an animal which does not have the disease, it would seem that the freeing of these areas from East coast fever was not the starvation of the ticks, but the freeing of the ticks of the organisms causing the disease.

Dipping. The usual and the most successful method employed in South Africa against ticks is dipping. A large trough is used through which the cattle are made to swim. A fenced passage which is divided several times by gates, leads up to the entrance of the dipping tank. By means of gates the number of animals approaching the dip can be regulated until only one passes into the dip at a time. A steep incline causes the animal to slip into the dipping fluid through which it swims to the other side, which is furnished with steps by which the animal can easily climb out.

There are a number of patent dipping fluids on the market, but the one found most useful is that recommended by Pitchford, which is

5 1-2 lbs. of soft soap.
2 gallons kerosene.
8 1-2 lbs. arsenite of soda
400 gallons of water.

Even dipping has its disadvantages, if the farmer has many species of ticks which he is desirous of destroying. If only *B. decoloratus* is to be destroyed, dipping every three weeks will catch all the ticks, which attach themselves to the animal. *R. evertsi* as is seen from the life cycle, only remains on the animal for a period of six or ten days as an adult. In order therefore to destroy all which may attach themselves the dipping would have to be done every week. If the farmer also wishes to destroy the brown ticks, *Rhipicephalus* sps. he would need to dip every three days to insure killing every tick which would attach itself to his animals. In order to make dipping every three days possible, the above formula has been modified to:

3 lbs. soft soap.
1 gal. kerosene.
4 lbs. arsenite of soda (20 percent arsenic).
400 gals. water.

Where wild animals are abundant on the farm, (they may far outnumber the stock animals)—the chances are that many ticks will be carried along upon them and never be destroyed by the dip. Heavy stocking the farm and frequent dipping however will greatly reduce the number of ticks. Where the farmer has his cattle grazing over one or two thousand acres, and must collect these and drive them through the dip every three days, it is found that it seriously interferes with any other farming operations in which he is engaged. It would seem, however, that, should dipping be done every week, although all the ticks which would attach themselves to the animal would not be killed, still by the law of chance, ticks which escaped the dip at one

time would be caught at a later date providing the dipping was continued over a number of years.

Conclusion. From the above brief account of the work which has been done and is being done, in South Africa, it will be seen that although the tick problem is a large one, much has been accomplished. It is now for the farmer to put into practice what has been learned of the ticks and the methods of their eradication. Many progressive farmers have built dipping tanks and are regularly dipping their cattle. There are still many who have not yet adopted good methods of ridding their farms of ticks, but it is to be hoped that soon, by united effort, the farmers will at least reduce the number of species of ticks which annually cause them loss.

THE EGG LAYING HABITS OF ADOXUS VITIS IN FRANCE

By C. R. Crosby

In speaking of the egg laying habits of the California grape rootworm (*Adoxus obscurus vitis*) H. J. Quayle (Calif. Agr. Exp. Station, Bull. 195, p. 11, 1908) states, "The eggs of this beetle are laid usually in crevices beneath the layers of bark on the old wood. . . . The same insect in France, according to Mayet, lays in the neighborhood of thirty eggs either singly or in patches on the under side of the leaves. This number is probably simply an approximation. The fact, if it is a common occurrence, that they are laid on the under side of the leaves, is the most striking difference between the habits in California and in France." In a footnote Quayle cites, Mayet's *Insectes de la Vigne*, p. 308, as authority for this statement.

This is certainly a striking difference of habit and out of curiosity the writer consulted Mayet's work and found on page 308 a statement to that effect but also discovered that it did not refer to *Adoxus* at all but to *Altica ampelophaga*. On page 326 Mayet describes the egg laying habits of Adoxus as follows: "Le nombre des œufs pondus est d'une trentaine environ; ils sont deposés, en captivité, dans les anfractuosités et les fentes du recipient où on élève l'insecte, ou les replis de papier, etc. Il est probable qu'à l'etat de liberté ils sont toujours placés sous les écorces, non loin du collet de la souche; c'est dans conditions-là M. Maurice Giard dit avoir observé plusieurs poutes." This agrees closely with the habits of the beetle in California as described in detail by Mr. Quayle.

LIME-SULPHUR WASH AN INEFFICIENT OVICIDE FOR CODLING MOTH

By V. I. SAFRO, *Oregon Agricultural College, Corvallis, Oregon*

Reports have occasionally been published showing a decrease in codling moth infestation following applications of a lime-sulphur wash. Until within the past few years a coating of lime-sulphur upon insect eggs has generally been considered fatal. Only recently have experiments shown a surprising lack of insecticidal power in spraying aphid and red spider eggs with lime-sulphur mixtures.

The Oregon Station, and doubtless other stations, has received letters from growers claiming a reduction in codling moth infestation due to applications of lime-sulphur. One grower even stated that summer applications alone of lime-sulphur had kept the crop practically free from codling moth.

This is a report of a short preliminary series of experiments conducted during the fall of 1911, in order to obtain data on the possible efficiency of lime-sulphur in killing the eggs of the codling moth. From an infested orchard, more than two hundred apples were collected upon which codling moth eggs had been deposited.[1] These were examined and only the apparently healthy eggs were used in the experiment.

Method of Facilitating Daily Observations. The small size of the eggs and their inconspicuous color rendered their necessarily frequent location and examination a rather slow process. A simple method was devised that resulted in but a minimum loss of time in locating eggs.

The side of the apple opposite the egg was cut to form a flat base. Each apple, then, rested on this base with the egg (where but one was present) on top. To still further facilitate location of the eggs and provide for the ready location of several eggs on one apple, an arrow was cut in the epidermis pointing to and but about one-fourth of an inch from the egg. The arrow, upon exposure to the air, turned brown and became quite prominent. It is interesting to note that the arrow was a very convenient place for the recently hatched larva to begin feeding. In fact, in almost every case, the young larva was found feeding in the arrow. Each apple was placed upon a slip of paper which bore the number of the apple and other data.

Conditions of the Experiment. The experiments were carried on

[1] Of the 221 apples collected, 198 had one egg each, 20 had two eggs each, one had three, and two had four eggs. In four cases the two eggs present on an apple were evidently superimposed, indicating two successive eggs from the same moth.

in a laboratory, the infested apples being placed upon desks safe[illegible] the direct rays of the sun. The daily maximum temperature o[illegible] room during the tests ranged from 64° F. to 71° F. All eggs [illegible] examined at least once a day and the appearance recorded. [illegible] maximum temperature outdoors ranged from 55° F. to 72° F.

On September 24th all eggs that had failed to hatch were exam[illegible] to ascertain, if possible, the condition of the embryo at death. W[illegible] the embryo appeared hard and dry it was recorded as "dried." W[illegible] the contents of the egg were watery the egg was recorded as "crush[illegible]" This was undoubtedly the case in some instances but the term is [illegible] in the absence of a certain knowledge of the cause of death. Emb[illegible] apparently normal but in which the development ceased before hat[illegible] ing was complete were recorded as "dead." These terms are indef[illegible] nite and signify nothing more than merely the appearance of the [illegible] contents.

At first an attempt was made to spray the apples by means of [illegible] atomizer. This method was given up as a failure because the spr[illegible] collected in drops covering only a small portion of the surface of the apple, in which case the egg was more frequently missed than [illegible] When the drops of spray were too large they would roll from the appl[illegible] leaving a practically dry surface. The same would frequently occur upon shaking the fruit. This was the first indication in the experime[illegible] of the inefficiency of a lime-sulphur spray for killing codling moth eggs. The failure of a spray to cover the eggs deposited on the fruit is sufficient to exclude it as a codling moth ovicide regardless of its efficiency in the laboratory.

The method adopted was to place a drop of the spray material directly upon the egg. If, then, with such treatment the insecticide failed, then the results would be doubly conclusive.

The eggs were divided into four lots. One lot remained untreated as a check. A second lot received a treatment of a one-to-30 dilution of lime-sulphur testing 30° B.[2] A third lot received lime-sulphur

[1] The appearance of the well known "red ring" and "black spot"; when the larva was visible throught the chorion with a hand lens the appearance was recorded as "larva."

[2] The author frankly admits that this specification of the "strength" of lime-sulphur, so often encountered in the literature, signifies absolutely nothing. It is true that the dilution is certain and known and if a *chemically identical* lime-sulphur concentrates were diluted similarly then the *biological* results would, under similar conditions, be similar. But all 30° B. lime-sulphurs are by no means identical even approximately so. Nor does it make matters any clearer to obtain an analysis showing the amount of total sulphur or total sulphid sulphur. Such data give no more definite idea of its efficiency as an insecticide (or, for that matter, as a fungicide) than a mere statement of its density. The reason for this uncertainty lies in

to 30 with arsenate of lead added at the rate of four pounds to 100 gallons of the diluted spray. The fourth lot was treated with a 1% solution of calcium polysulphides containing a slight amount of CaS_2O_3, furnished by Prof. H. V. Tartar, of the Oregon Experiment Station. The eggs were treated on the day collected.

Results with Unsprayed Apples. As a check, ninety-three eggs were left untreated in the laboratory. Of these, ninety hatched, one was accidentally crushed and two failed to hatch "due to natural causes."

Notes on the Appearance of the Developing Eggs. It was noted, in recording the appearance of the eggs, that of the twenty-six white eggs in the lot, only five showed a red ring before the appearance of the black spot. The eggs recorded as having a red ring showed all variations from the merest trace of red to a deep red circle, many showing but fractional rings. In one case (35 a) the egg hatched without the black spot becoming visible through the chorion. Additional data in the tables are included as records on development.

Lime-sulphur Wash (30° B.) 1 30. One hundred eggs were treated with a one-to-30 dilution of clear lime-sulphur testing 30° B. Of this number 85 hatched, one was accidentally killed and 14 failed to hatch due to other causes. This fourteen percent includes, undoubtedly, some "natural" and "accidental" mortality. Deducting these latter items—or even ignoring them—the lime-sulphur mortality amounts to very little indeed. Were every codling moth egg in an orchard hit

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that a specific gravity determination of a lime-sulphur solution is really a reading of two (at least) solutions of unknown densities, present in unknown proportions, and of radically different degrees of chemical activity. These two solutions are the calcium polysulphides (CaS_4 and CaS_5) and the calcium thiosulphate ($CaSO_3$). Of these solutions the polysulphides are by far the most active, chemically and undoubtedly the most important insecticidal ingredient in lime-sulphur.

The length and rapidity of boiling and cooling the spray are important factors causing the variation in proportion of calcium thiosulphate to the calcium polysulphides, the proportion of polysulphides increasing with the length of boiling and the thiosulphates increasing with the rapidity of cooling. The knowledge of the resulting density of the solution gives no definite idea of its chemical nature. Of the two solutions, the one lower in density may be much more active due to the larger amount of polysulphides present in proportion to the thiosulphate. For the same reason a dilution of one concentrate may be fully as effective as a "stronger" dilution of another. The bearing of this problem on the occurrence of spray injury to the foliage is discussed by the author in a forthcoming publication.

The nearest approach, at present, to a logical determination of the "strength" of lime-sulphur is a statement of the amounts present of calcium polysulphide and calcium thiosulphate. The author used a 5% solution of calcium polysulphide as a more certain test in addition to "a one-to-30 dilution of lime-sulphur testing 30° B."

UNTREATED EGGS DETAIL TABLE

No. of apple	Collected		Subsequent appearance				Hatched
	Sept.	Appearance	Sept.		Sept.		Sept
16 a	9	white	10	black spot	11	larva	12
46 a	9	white	10	black spot			12
49 a	10	white	11	black spot			12
60 a	10	white	11	black spot	12	larva	13
62 a	10	white	11	black spot	12	larva	13
52 a	10	white	12	black spot			14
7 a	9	white	12	black spot	13	larva	14
33 a	9	white	12	black spot	13	larva	14
59 a	10	white	14	black spot			16
44 a	10	white	16	black spot			18
1 a	9	white	16	black spot	17	larva	18
3 a	9	white	10	red ring	17	black spot	18
6 a	9	white	16	black spot			18
9 a	9	white	17	black spot			18
41 a	9	white	10	black spot	17	larva	18
68 a	10	white	11	red ring	18	black spot	19
2 a	9	white	17	black spot	18	larva	19
14 a	9	white	17	black spot	18	larva	19
21 a	9	white	14	red ring	18	black spot	19
22 a	9	white	17	black spot	18	larva	19
56 a	10	white	18	black spot	19	larva	20
73 a	10	white	12	red ring	19	black spot	20
84 a	10	white	11	red ring	18	black spot	20
82 a	10	white	19	black spot			20
79 a	10	red ring	11	black spot			12
15 a	9	red ring	10	black spot	11	larva	12
19 a	9	red ring	10	black spot			12
23 a	9	red ring	11	black spot			12
24 a	9	red ring	10	black spot			12
29 a	9	red ring	10	black spot			12
35 a	9	red ring	11	black spot			12
35 a	9	red ring					12
46 a	10	red ring	11	larva			13
51 a	10	red ring	11	black spot	12	larva	13
54 a	10	red ring	11	black spot			13
58 a	10	red ring	11	black spot	12	larva	13
66 a	10	red ring	11	black spot	12	larva	13
69 a	10	red ring	12	larva			13
71 a	10	red ring	11	black spot			13

UNTREATED EGGS. DETAIL TABLE – (...)

Collected		Subsequent appearance						
Sept.	Appearance	Sept.		Sept.				
9	red ring	11	black spot					
9	red ring	11	black spot					
9	red ring	12	black spot					
10	red ring	13	black spot					
10	red ring	12	black spot					
10	red ring	13	black spot					
10	red ring	12	larva					
10	red ring	12	black spot					
9	red ring	12	black spot					
9	red ring	12	black spot	13	larva			
9	red ring	12	black spot	13	larva			
9	red ring	12	black spot	13	larva			
9	red ring	12	black spot					
9	red ring	13	black spot					
9	red ring	12	black spot					
9	red ring	14	larva					
9	red ring	10	black spot	11	larva			
9	red ring	13	black spot	14	larva			
9	red ring	13	black spot	14	larva			
9	red ring	14	larva					
10	red ring	14	black spot					
10	red ring	14	black spot					
10	red ring	14	black spot	15	larva			
10	red ring	16	black spot					
9	red ring	15	black spot					
9	red ring	15	black spot					
10	red ring	17	black spot					
10	red ring	16	black spot					
9	red ring	17	black spot					
9	red ring	16	black spot					
10	red ring	17	black spot					
10	red ring	17	larva					
10	red ring	18	black spot					
10	red ring	18	black spot					
9	red ring	14	larva			crushed	14	
9	black spot						16	1
9	black spot						12	1
9	black spot						14	
9	black spot						10	
9	black spot						8	1
9	black spot						10	
10	black spot						11	1
10	black spot						11	1
10	black spot						12	
10	black spot						13	1
10	black spot						12	1
10	black spot						11	
10	black spot						11	1
10	black spot						11	1
10	black spot						11	1
9	black spot						12	1
10	black spot					crushed	11	
10	black spot	12	larva			dried	17	

LIME-SULPHUR WASH (30° B.) 1-30, DETAIL TABLE

No. of apple	Collected		Subsequent appearance				Hatched
	Sept.	Appearance	Sept.		Sept.		Sept.
63 b	10	white	11	black spot			12
67 b	10	white	11	larva			13
71 b	10	white	12	black spot			13
38 b	9	white	12	larva			13
66 b	10	white	13	black spot			14
51 b	10	white	14	black spot	15	larva	16
15 b	9	white	16	black spot			17
24 b	9	white					17
58 b	10	white	16	black spot			18
9 b	9	white	10	red ring	17	larva	18
43 b	9	white	16	black spot			18
50 b	10	white	16	black spot			19
68 b	10	white	16	black spot	18	larva	19
7 b	9	white	18	larva			19
24 b	9	white	17	black spot			19
25 b	9	white	14	red ring	17	black spot	19
28 b	9	white	17	black spot			19
30 b	9	white	17	black spot			19
54 b	10	white	19	black spot			20
71 b	10	white	18	black spot			20
72 b	10	white	19	black spot			21
71 b	10	red ring	12	black spot			12
72 b	10	red ring	11	black spot			12
78 b	10	red ring	11	black spot			12
5 b	9	red ring	10	black spot			12
11 b	9	red ring	11	black spot			12
16 b	9	red ring	10	black spot			12
18 b	9	red ring	10	black spot	11	larva	12
20 b	9	red ring	10	black spot	11	larva	12
32 b	9	red ring	10	black spot			12
48 b	10	red ring	11	black spot	12	larva	13
49 b	10	red ring	11	black spot	12	larva	13
53 b	10	red ring	11	black spot			13
55 b	10	red ring	11	black spot	12	larva	13
56 b	10	red ring	11	black spot	12	larva	13
57 b	10	red ring	12	black spot			13
71 b	10	red ring	12	black spot			13
75 b	10	red ring	11	black spot			13
81 b	10	red ring	12	black spot			13
84 b	10	red ring	11	black spot	12	larva	13
1 b	9	red ring	11	black spot	12	larva	13
3 b	9	red ring	10	black spot	12	larva	13
12 b	9	red ring	12	black spot			13
19 b	9	red ring	11	black spot	12	larva	13
29 b	9	red ring	11	black spot	12	larva	13

LIME-SULPHUR WASH (30° B. 1·30) DETAIL TABLE [illegible]

Collected		Subsequent appearance						
Sept.	Appearance	Sept.		Sept.		Larvæ	Hatched Sept.	Not hatched
9	red ring	11	black spot	12	larva		13	4
10	red ring	10	black spot	12	larva		13	4
10	red ring	11	black spot	12	larva		14	4
10	red ring	13	black spot				14	4
10	red ring	13	black spot				14	4
10	red ring	13	black spot				14	4
10	red ring	12	larva				14	4
9	red ring	12	black spot	13	larva		14	5
9	red ring	11	black spot	12	larva		14	5
9	red ring	12	black spot				14	5
9	red ring	12	black spot				14	5
10	red ring	13	black spot	14	larva		15	5
9	red ring	13	black spot	14	larva		15	6
9	red ring	13	black spot	14	larva		15	6
10	red ring	14	black spot	15	larva		16	6
10	red ring	14	black spot				16	6
9	red ring	13	black spot	14	larva		16	7
9	red ring	13	black spot	14	larva		16	7
9	red ring	13	black spot				16	7
10	red ring	11	black spot	14	larva		17	7
10	red ring	13	black spot				17	7
10	red ring	14	black spot	16	larva		17	7
9	red ring	16	black spot				17	8
10	red ring	13	black spot				17	8
10	red ring	16	black spot				17	8
9	red ring	16	black spot	17	larva		18	9
9	red ring	15	black spot				17	9
10	red ring	16	black spot				18	9
10	red ring	18	larva				20	10
9	red ring					dried	16	
9	red ring	11	black spot	12	larva	dried	23	
9	red ring					dried	17	
10	red ring	12	black spot	13	larva	dried	23	
10	red ring	12	black spot			dried	24	
10	red ring	16	black spot			dried	24	
10	red ring	16	black spot			dried	24	
10	red ring	14	black spot			dried	24	
9	black spot						11	1
9	black spot						10	1
10	black spot						11	1
10	black spot						11	1
10	black spot						11	1

LIME-SULPHUR WASH (30° B.) 1-30, DETAIL TABLE—*Continued*

No. of apple	Collected		Subsequent appearance			Hatched
	Sept.	Appearance	Sept.		Embryo Sept.	Sept.
33 b	9	black spot				21
39 b	9	black spot				21
40 b	9	black spot				21
40 b	9	black spot	11	larva		14
23 b	9	black spot			dried	24
35 b	9	black spot	11	larva	crushed	24
37 b	9	black spot	11	larva	crushed	24
39 b	10	black spot	11	larva	dried	24
60 b	10	black spot			dried	24
56 b	10	black spot	10	larva	dried	24
80 b	10	larva			dried	24

and covered by the spray (which is impossible practically) the large percent mortality according to these results would be about 14 per cent. In view of the fact that a foliage spray must be used when spraying for codling moth eggs, a one-to-30 dilution of a clear lime-sulphur solution is about as "strong" as would ordinarily be used. This preliminary experiment demonstrates to our satisfaction the ineffectiveness of lime-sulphur as a codling moth ovicide.

Notes on Development. In this lot, of twenty-one white eggs only two showed the red ring before the appearance of the black spot. Almost all eggs with a red ring when collected showed the black spot before hatching.

All the white eggs hatched. Of the sixty-three eggs with white or fractional red rings when collected, eight, about 13 percent, failed to hatch. Of fifteen eggs showing the black spots when collected six, 66 2-3 percent, failed to hatch. These records seem to indicate that the eggs are killed later on in their development—at a period when the embryo requires the most oxygen. Of the fifteen dead eggs the fully developed embryo, recorded as "larva," was visible through the chorion in eight. The embryo may have been as fully developed in the other eggs but on account of the residue of the spray or the opacity of the chorion could not be seen.

Lime-sulphur Wash (30° B.) 1-30 and Lead Arsenate 4-100. Would the addition of the usual strength (4 pounds in 100 gallons) of lead arsenate be effective in preventing the eggs from hatching? To obtain data on this question a third lot of twenty-three eggs were treat-

of these, sixteen hatched, the larvæ all surviving. Taking for granted that the seven failing to hatch were killed by the treatment still the survival amounted to about 70 percent, indicating the futility of spraying with lime-sulphur and lead arsenate to prevent hatching of the eggs.

LIME-SULPHUR WASH (30° B.) 1-30 AND LEAD ARSENATE 4-lbs. DILUTE 1-100

No. of egg	Collected		Subsequent appearance			Remarks	Hatched Sept.	No. days to hatch
	Sept.	Appearance	Sept.					
1	11	white	20	black spot			21	10
2	11	white	20	black spot			21	10
3	11	red ring					19	8
4	11	red ring	19	black spot			20	9
5	11	red ring	19	black spot			20	9
6	11	red ring	18	black spot			20	9
7	11	red ring					21	10
8	11	red ring				dead	24	
9	11	red ring				dead	24	
10	11	red ring	15	black spot		crushed	24	
11	11	red ring	18	black spot		dead	24	
12	11	red ring	16	black spot		dead	24	
13	11	black spot					18	7
14	11	black spot					18	7
15	11	black spot					21	10
16	11	black spot	18	larva			21	10
17	11	black spot					23	12
18	11	black spot					23	12
19	11	black spot					20	9
20	11	black spot					19	8
21	11	black spot				crushed	24	
22	11	black spot				dead	24	
23	11	larva					21	10

Calcium Polysulphides (5 percent Solution). The lime-sulphur used in the previous experiments was undoubtedly, to some extent, the cause of the death of the embryo. In order to obtain some data

on the possible effect of the stronger, more accurately known, solu... twenty-eight eggs were treated with a 5 percent solution of calc... polysulphides. This strength is equivalent to a lime-sulphur dilu... of about one to eight, more or less, depending upon many fact... Of the twenty-eight eggs treated, eight hatched. The twenty fai... to hatch included probably some natural mortality. In all res...

FIVE PER CENT CALCIUM POLYSULPHIDES, DETAIL TABLE

No. of apple	Collected		Subsequent appearance					
	Sept.	Appearance	Sept.	Sept.			Hatched Sept.	N...
23 e	11	white					21	
7 e	11	white				crushed	24	
10 e	11	white	12	black spot		dead	24	
11 e	11	white				dead	24	
13 e	11	white				dead	24	
16 e	11	white				crushed	24	
17 e	11	white				dead	24	
26 e	11	white				crushed	24	
12 e	11	red ring					12	
18 e	11	red ring	13	black spot			15	
2 e	11	red ring	13	black spot	14 larva		16	
20 e	11	red ring	12	black spot			16	
28 e	11	red ring					17	
30 e	11	red ring	15	black spot	16 larva		17	
3 e	11	red ring	17	black spot	18 larva		19	
5 e	11	red ring				crushed	24	
15 e	11	red ring				dead	24	
19 e	11	red ring				dead	24	
22 e	11	red ring	14	black spot		crushed	24	
24 e	11	red ring	16	black spot		dead	24	
25 e	11	red ring				dead	24	
27 e	11	red ring	18	black spot		dead	24	
1 e	11	black spot				dried	24	
4 e	11	black spot				crushed	24	
9 e	11	black spot				dead	24	
14 e	11	black spot	15	larva		dead	24	
6 e	11	larva				dried	24	
29 e	11	larva				dead	24	

this kind it should be remembered that the number of eggs hatched is of much greater importance than the number failing to hatch. With these results, then, it is evident that lime-sulphur, even too strong for use on foliage and fruit is, at best, an uncertain ovicide, its effectiveness of doubtful value economically.

WOOLLY APHID MIGRATION FROM ELM TO MOUNTAIN ASH[1]

Schizoneura lanigera (americana)

By Edith M. Patch

In the vicinity of Orono, the woolly aphid of the apple, *Schizoneura lanigera*, was abundant during the late summer and autumn of 1911 upon water shoots of certain apple trees; and upon trunk and branches of native mountain ash, *Pyrus* (*Sorbus*) *americana*; cultivated ornamental species of mountain ash, *Pyrus sitchaensis* and others; and native and cultivated species of hawthorn, *Crataegus*. Some of each of these trees were located with the view of studying the overwintering forms of this aphid, some of which, according to all published accounts, migrate up from the base of the tree in the spring to tender and susceptible places on the bark where they establish bark feeding colonies. No such occurrence, however, took place here the spring of 1912. The identical trees which were heavily infested with woolly aphid last fall were free from infestation this spring until late in June and then the infestation did not come from root aphids. Whether *lanigera* ever overwinters on the apple in this climate one season's observations are of course insufficient to ascertain. I had heretofore taken it for granted that it would do so and this point has not been previously investigated in this locality. Testimony as to this habit is desirable from other northern states and I shall plan to continue observations here for some years to come. It should be stated that these notes concern the trunk, branches and water shoots only; no roots being examined. If, however, root forms were present they and their progeny certainly remained buried this spring, as daily observations of selected trees were made. It seems not improbable that the hard packed condition of the clay soil in this immediate vicinity may be partly responsible for this circumstance. The fall migrants of this colony were mature and taking flight September 20-23.

[1] Papers from the Maine Agricultural Experiment Station: Entomology No. 59.

Through the kindness of several southern entomologists, elm curl in considerable abundance with winged forms ready for migra was secured in May. These migrants as previously explained (Sci Vol. 36, pp. 30–31) were caged over apple seedlings greenhouse-gro for the purpose, the seeds having been planted in December 1911 January 1912. A few very successful colonies of woolly aphids were thus established on apple seedlings by the progeny of the elm migra the earliest of which was one started by migrants received May 12 which is still flourishing, even in indoor conditions, at the time this paper goes to press.

Encouraged by the successful indoor tests,[1] outdoor tests under more favorable conditions were made when the winged forms appeared in this vicinity.

Water shoots had been allowed to grow about the base of a mountain ash, *Pyrus sp.* on the campus and up to June 21 this tree and the shoots were free from woolly colonies. As the migrants are much more docile about sundown than earlier in the day, I placed several hundred elm migrants at the base of the water shooots, about 7 p. m. on June 21. They moved about a little, most of them creeping to the ventral side of a leaf and remaining there; and during the night producing nymphs which sought the leaf axils of the water shoots so that by the afternoon of June 22 the tiny nymphs had already fed enough and secreted enough white wax to give the typical "woolly" appearance to the colonies. These and their progeny thrived on the mountain ash in a perfectly normal way for the woolly aphid of the apple.

Similar successful results were obtained by evening "plantings" of elm migrants upon uninfested water shoots of apple on June 24.

By this time the elm curl migrants were settling of their own accord on leaves of both mountain ash and apple and by June 28 colonies

[1] A very high percent of the indoor attempts to establish colonies upon seedlings, both with the material from the south and with Maine collections unsuccessful. The reasons for the failures I do not know. The seedlings grown from seeds removed from apples on the Maine market and it is possible many of these plants were varieties not susceptible to attack. Though healthy seedlings were rather a scrubby lot, having received no fertilizer on the theory "neglected orchards suffer worst from attacks of woolly aphids." The later door experiments showed that the most vigorously growing water shoots of and mountain ash (*Pyrus*) were most readily accepted, which would indicate the the seedlings had been forced as they are in the nursery they might have been bait. I think, too, that freshly moulted migrants are often too restless and ac tively impelled to flight and dispersal to take kindly to confinement. Whatever trouble, I have often had cause to recall Riley's remark on this species. —"Th much greater difficulty in fully tracing the life-history of one of these small cre than might be supposed. They languish in confinement and ill bear handling

1. *Meloïdus cuba*, egg blister, one opened to show the egg and the one at the right intact

2. Nymphs of the Woolly Aphid, *Schizoneura lanigera (americana)*, on mountain ash, *Pyrus americana*—the immediate progeny of migrants from elm leaf curl. Photographed at Orono, June 28, 1912.

nymphs of woolly aphid were easily found on both these summer hosts. That these were the progeny of the elm leaf migrants there was evidence enough. One native mountain ash, *Pyrus americana*, will serve for an illustration. The main trunk of this tree was dead nearly to the ground, but twelve vigorous shoots had grown up measuring about five feet each. On June 28 this mountain ash had about 150 woolly masses of nymphs grouped on the stem at the leaf axils. These nymphs ranged from very tiny ones to half grown insects, none being mature at that date. One such woolly mass contained 155 individuals of various sizes. See plate 10, figure 2. On the ventral surfaces of the leaves of this mountain ash were stationed many elm leaf migrants producing there their broods of nymphs which could be seen, with the hand lens, to be augmenting the woolly masses on the stem. Collections of these migrants thus stationed were made as follows:—July 2, 88 migrants; July 3, 211 migrants; July 5, 92 migrants; July 8, 54 migrants; July 9, 80 migrants; July 10, 35 migrants; July 11, 11 migrants; July 12, 3 migrants. Only living individuals were collected, dead ones being brushed off and discarded in the counts. Microscopic examination showed them to be identical with winged forms collected in elm leaf curls. Two large elm trees with leaves well stocked with this species stood about a rod distant.

Correlated with the appearance of the stem colonies of woolly aphides on mountain ash (*Pyrus* sp.) and water shoots of apple which were definitely ascertained to be the progeny of elm leaf migrants, were woolly bark feeding colonies on the trunks and branches of the elm, *Ulmus americana*. These were mostly about pruning wounds or protected under the bark, the latter colonies often not visible except on scaling back the bark. That these bark colonies on the elm are also the progeny of elm leaf migrants I have no doubt; but as the chief point of interest this year was centered in watching the elm leaf-apple situation no real attempt was made to get at the elm leaf-elm bark situation by catching the bark colonies in the process of making. This should not be especially difficult to do and is listed among the plans for 1913. In this connection it should be remembered that Riley's classic work on this species gives a continuous cycle for the elm in which he states of the *fourth generation* (progeny of the winged generation developing in the leaves): "They are, however, able to sustain themselves on the tender bark of twigs alone, and may be found nearly fully-grown, there exposed to view and enveloped in the white cottony matter, which brushes off at the slightest touch."

What influences the destination of the elm-leaf migrants and what determines their choice of the summer food plant for their progeny is not known. That they readily accept elm bark under some conditions

Riley's account testifies. That they migrate to water shoots of ap to mountain ash (*Pyrus* species) and to hawthorns (*Crataegus* speci there producing progeny known as the woolly aphid of the appl have had definite and repeated proof.

The woolly colonies (mostly hidden under rough bark) are season more abundant upon the elm than upon the apple in this vic ity, comparatively few of the apples being colonized, the mount ash being here conspicuously a favorite summer host for *Schizone lanigera* (*americana*).

A bulletin of the Maine Agricultural Experiment Station (No. 20 now in press treats of certain phases of this problem not touched upo in the present paper.

An especial study of the antennal variation of this species is unde way, it being purposed to tabulate at least 1000 antennæ, with camer lucida sketches of the more significant variations. The two extreme of the variable series show a difference wide enough to "separat *lanigera* from *americana* on good antennal characters." However, a large series renders a separation on this basis impossible. Although the discussion of this important point is postponed until the requisit data are tabulated, it may be of interest in this connection to stat that a single collection of elm leaf migrants made at Orono show a range of from 19 to 32 annular sensoria on antennal joint III, 4 to 9 on IV, 2 to 10 on V, 0 to 2 on VI.

White Grubs (*Lachnosterna* species). These common pests were excessiv abundant the past summer, at least in Albany, Columbia and Rensselaer counti N. Y., they being so very numerous in many fields as to destroy practically the grass roots so that large patches were badly pulled by the horse rake. Str berry beds and corn were also seriously affected, especially when planted on s The greatest damage was confined to old seedings or meadows and usually to moi portions of the fields. These grubs were probably a little over a year old and m be those of *Lachnosterna fusca* Froh., since this was one of the species abunda in May and June 1911. In addition to these two, *L. grandis* Sm., *L. hirticula* Kn and *L. hirsuta* Knoch were observed in abundance last year. Several species June beetles were numerous last spring so that a continuance of the above no depredations, probably on a more limited scale, may be expected in 1913.

E. P. Felt

SCIARA SCIOPHILA LARVÆ CONGREGATING IN CHAINS

By J. S. HOUSER, *Department of Entomology, Ohio Agricultural Experiment Station, Wooster, Ohio*

About the middle of July of the present year there was reported to this department by Mr. C. R. Neillie, of the Cleveland City Department of Forestry, a serious outbreak of this insect, occurring on a lawn in Shaker Heights, Cleveland, Ohio. The writer was detailed to investigate the trouble and found that the insects had been present for two or three weeks. During this interval, on account of their repulsive appearance they had been causing the inhabitants of the place a great deal of discomfort.

I was told by one member of the household as well as by the gardener, that the larvæ, especially in the early mornings, had exhibited a tendency common with some members of this family, to march in chains about the lawn, on the drives, along the foundation of the house and in similar places, but I was unfortunate in arriving just after the gardener had completed his customary morning rounds of pouring gasoline upon the insects and hence I did not see them in motion. The columns, however, were said to have varied in size from a half inch in width and two or three inches long, to those four inches in width and two or three feet long.

Something of the magnitude of the scourge may be gained from the fact that about a hundred gallons of gasoline had been used for killing the insects and that the putrid decaying masses of their bodies were to be seen in sheltered crannies everywhere, though in greater quantity along the walls of the house, at the bases of trees, along the sides of the walks, etc. On a number of places in the lawn, grass had been killed by the gasoline over areas of several square feet.

At the time of my visit the numbers of the larvæ were decreasing, but the flies were still abundant on the lawn and in the bordering woods. A collection was taken from both places, as was also one of larvæ and pupæ from the decaying mould of the woods. Within a short time adults emerged from the latter, and specimens of all three lots were sent to Dr. O. A. Johannsen, to whom I am indebted for the determination of the species. The insects developed not only in the woods, but in the lawn proper as well, for both larvæ and pupæ were found in the turf. As far as I was able to determine, the scourge was confined to the one lawn of about an acre and a half in extent.

"THE MINNESOTA FLY TRAP"

By F. L. Washburn, *Experiment Station, St. Anthony Park*

We have found the trap described herewith a valuable auxiliary reducing the number of flies where these occur in large quanti

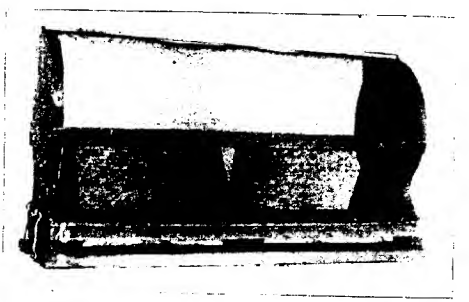


Fig. 7. General View of Trap

The trap is twenty-four inches long, twelve inches high and eig inches wide. It has been given a thorough test this summer with mo satisfactory results. Whether the traps are rectangular or ova

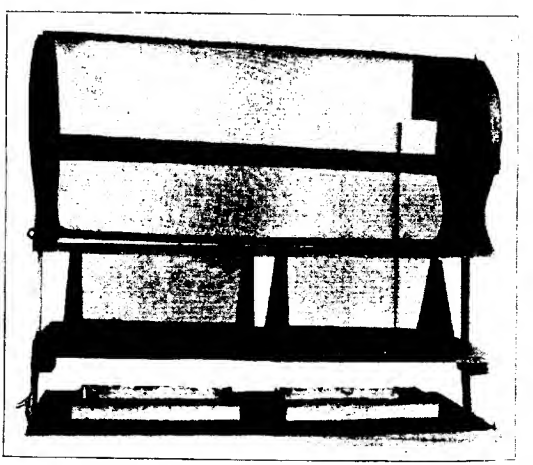


Fig. 8. The three parts of trap separated to show construction. The up pieces at the ends are not a part of the trap.

...is to make no difference as regards their efficiency. The screen used ordinary wire mosquito screen and that and the small amount of ...ber required made each trap cost us 11c. for material. Made in ...e numbers the cost would be very much less. A skillful carpenter ...ld easily construct this apparatus in two or three hours. The ...per oval part (*c*) serves as a receptacle which the flies enter through ...e opening in the top of the middle portion *b* made of screen and ...aped like the roof of a house. Under this is the base board *a*, ...on which rest two tin bait pans. The space between the base board ...d the middle portion is about one-half inch, and between this and ...e bait pans through which flies enter pans, about one-fourth of an ...h.

The record made by one of these traps is in part as follows:

Rear of dining hall on campus, two days, 5000 flies.
Dairy Barn, one day, 1700 flies.
Rear of dining hall, five days, 13,000 flies.
Same place, three days, 6000 flies.
Same place, one day, 4200 flies.
On back porch of a dwelling not far from a stable where a few horses are kept, two days, 8700 flies.
Same place, one day, 12,000 flies.
Same place, one and a half days, 18,800 flies.

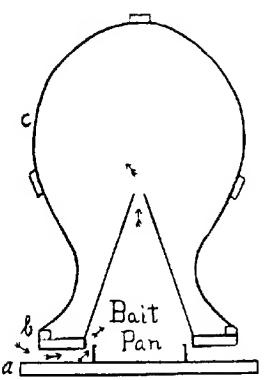


Fig. 9. Cross section of trap.

Bait: This is an extremely important factor in the use of this trap, as we find we have to qualify to a certain extent previous recommendations in this regard. Ordinarily, we believe that bread and milk, frequently renewed, is the best bait for this and other fly traps, but under certain conditions, this is not as attractive as it might be. For example: We loaned one of these traps to a dining hall association

on the State Fair grounds this month to be used in the kitch... was found that waste, stale meat thrown into a box was more a... tive to the flies than bread and milk in the trap. This was ov... by putting small pieces of the stale meat in the pans with the ... and milk and the receptacle of the trap was soon swarming ... thousands of flies.

The flies, which gather in the upper part or receptacle, shou... killed by immersing that part of the trap in hot water or pouring ... ing water over it, or in any other way not injurious to the trap. ... dead flies may be emptied out of the trap, the bait renewed and ... trap reset.

We have been so pleased with the success of this contrivance ... we have proposed for it the name which is used at the head of ... article.

ARTHROCNODAX OCCIDENTALIS N. SP. (DIPT.)

By E. P. Felt, *Albany, N. Y.*

The small, yellowish species described below and easily separated from other American forms by the emarginate ventral plate, was reared July 15 and 30, 1912, by H. J. Quayle of the Division of Entomology, University of California, Berkeley, from larvæ preying on red spiders, Tetranychus species.

Male. Length 1 mm. Antennæ a little longer than the body, thickly h... pale straw, yellowish basally; 14 segments, the fifth having the stems with a ... 2 1-2 and 3 1-2 times their diameters. Palpi; the first segment short, irregular; ... second with a length over twice its width, the third 1-2 longer than the second; ... fourth a little longer than the third, slender. Mesonotum fuscous yellowish ... tellum and postscutellum yellowish. Abdomen pale yellowish, with a ... orange spot basally. Halteres yellowish transparent. Wings hyaline. Legs ... pale straw, the distal tarsal segments somewhat darker; claws slender, evenly ... the pulvilli as long as the claws. Genitalia fuscous yellowish, both dorsal and v... plates triangularly emarginate, each with the lobes sparsely setose apically.
a 2328.

THE EGG OF THE BLACKBERRY LEAF-MINER

Metallus rubi Forbes (*Scolioneura capitalis*

C. R. CROSBY, *Ithaca, N. Y.*

Prof. C. O. Houghton has recently published an excellent account of the Blackberry Leaf-miner (Del. Agr. Exp. Sta. Bull. 87, 1910 it states that he has not observed the egg. The following note is presented to help fill this break in our knowledge of the life-history of the insect.

On August 25, 1908, the writer visited a large field of dewberries at Ripley, N. Y., which earlier in the season had been rather severely infested. The larvæ of the second brood were just beginning their mines. A careful examination of the under side of the leaves showed that the mines usually start near a prominent vein and that at their base a small round blister is present. These blisters are about .75 mm. in diameter, nearly round, low, green in color, and have a smooth surface. They are usually found close to a prominent vein and *two* are often placed close together. The egg itself is nearly white, smooth, flattened and lies between the two layers of the leaf. Plate 10, fig. 1 shows one of the blisters intact; the other has been opened and the egg partly removed. The blisters are rather inconspicuous but after one becomes used to looking for them can be easily detected without the aid of a lens.

According to the observations of Professor Houghton the eggs are probably inserted into the leaf from the upper side (Ent. News, XIX, p. 213, 1908)

Fall Army Worm (*Laphygma frugiperda* Sm. & Abb.). This insect was exceptionally abundant the latter part of September and early October in Jamaica and Flushing in the vicinity of New York city and on the eastern extremity of Long Island. There were several complaints of serious injury to lawns, the parties reporting the grass to be so seriously affected that they were fearful it would be destroyed. The caterpillars were reported very injurious to corn on Long Island. The larvæ, which are characteristic of this species, vary greatly in coloration. This outbreak, or one for New York state or else, owing to the lateness of the season when the pest was generally abundant, is generally overlooked.

J. P. Moore

APHID NOTES FROM CALIFORNIA

By W. M. Davidson,[1] *U. S. Bureau of Entomology, San José, Cal.*

The following paper reports several plant-lice not heretofore [illegible] in California, of which three species are new to science. A few [illegible] forms are also dealt with and illustrated.

Ceratophis lantaniae Boisd.

Taken in the spring of 1912 on ferns in the greenhouses of Stan[illegible] University, Cal., by Mr. H. Morrison.

Phyllaphis coweni Gillette.

Syn. *Cryptosiphum tahoense* Davidson (Jour. Econ. Ent. Dec. 191[illegible]

I have not seen the types of *Phyllaphis coweni* but after compar[illegible] Gillette's description of this aphid (Can. Ent. xxxvii p. 125, 1905) [illegible] my description and specimens of *C. tahoense* I conclude that there but one species.

Calaphis betulaecolens Fitch (Fig. 1, 2).

Alate male. Pale yellowish-green. Head, prothorax, thoracic lobes and [illegible] spots at the base of the wings black. Antennae reaching beyond cauda, ve[illegible] apices of joints 3-6 and the filament dusky. Length of the joints as follows, 3, [illegible] filament, 6, 1, 2. Legs yellow, femoral apices brown, base and apex of tibiae and [illegible] tarsi dusky. Wings large, stigma light gray with a large paler central area. Le[illegible] third of stigmatic vein obsolete. Second fork of third discoidal slightly nearer [illegible] first fork than to apex of wing. Subcosta and discoidals stout, dark brown. Abd[illegible] men narrower than thorax, shorter than the head and thorax combined, green[illegible] yellow, with a dorso-median black transverse bar on all the segments except the [illegible] Cornicles pale, almost as broad as long, situated on segment 7. Pale lateral tuber[illegible] occur on segments 2-6. Last segment dusky grey. Beak very short, reach[illegible] first coxae, stout and pale, the tip black. Under side of the thorax grey. Sense[illegible] as follows: III, 18-24; IV, 0-X; 1-VI, 1.

Measurements:		Antennal joints	
Body, length	2.05mm	I	[illegible]
" width	1.51mm	II	[illegible]
Wing expanse	7.70mm	III	[illegible]
Cornicles	.08mm	IV	[illegible]
		V	[illegible]
		VI	[illegible]
		fil.	[illegible]

Oviparous female. Pale yellowish-green, caudal half of abdomen with a re[illegible] tinge. Antennae reaching to cornicles or beyond, black, joints 1, 2, basal h[illegible] both 3 and 4 paler. Eyes red. Legs pale, base of tibiae and tarsi black. Cor[illegible] longer than broad, the mouth flaring. Dorsum of body sometimes with ind[illegible] dusky markings. Abdomen oval, the last three segments forming a conical ad[illegible]

[1]Published with the permission of the Chief of the Bureau of Entomology.

Measurements; Body, length 3.13mm Antennal joints I .142
" width 1.37mm II .076
Cornicles .16mm III .082
IV .091
V .117
VI .091
fil. .1..

The sexual forms occur in November on cultivated Birch. Locality, Oakland, Cal.

Callaphis castaneae Buckton (Figs. 3, 4).

Alate male. General color lemon. Eyes dark red. Antennae reaching beyond the tip of the abdomen, dusky, joint 3 the longest and three times as long as the filament. Sensoria distributed as follows: joint 3, 20; joint 4, 7; joint 5, 8; joint 6, 4. Thoracic lobes and scutellum brownish. Wings of medium size, stigmacic vein deeply curved, second fork of third discoidal slightly nearer to the wing apex than to the first fork. Stigma light brown, central portion lighter. Legs pale, tibial apices and base of hind tibiae dusky. Abdomen narrower than the thorax, tapering gradually caudad, each segment with a median oval dusky area and dusky lateral spots. Cornicles dusky, almost twice as long as broad. Cauda scimitar, dusky, shorter than the cornicles. Beak pale, tip black, reaching nearly between first and second coxae.

Measurements; Body, length 1.33mm Antennal joints I .064
" width .50mm II .035
Wing expanse 4.87mm III .621
Cornicles .06mm IV .113
V .285
VI .120
fil. .194

Oviparous female. General color pale lemon yellow. Eyes dark red. Antennae not quite reaching to cornicles, pale, with the articulations and filament dusky, joint 3 longest, twice as long as the filament or as joint 5. Body oval, tapering posteriorly to the cornicles, beset with many long delicate spines. Abdominal segments 1-8 each with two oval, transverse dusky areas on the dorsum. Cornicles pale, twice as long as broad. Cauda bluntly rounded, short. Legs pale, tarsi and tibial apices dusky.

Measurements; Body, length 2.11mm Antennal joints I .071
" width .95mm II .050
Cornicles .12mm III .114
IV .247
V .190
VI .115
fil. .176

The sexual forms are found on Chestnut in early November. Locality, San José, Cal.

Callaphis betulae Kalt. (Fig. 5.)

Oviparous female. Slightly woolly, body spindle-shaped, broadest at the abdominal segment. Head and dorsum of the prothorax greyish-brown. red. Antennæ mostly dusky, reaching to the base of the cornicles, on small tubercles, joint 3 the longest and in order after that 4, 5, 6, the filament. 1 Rest of thorax and abdomen greenish-yellow or yellowish-brown, meso- and thorax and first five abdominal segments with lateral black spots and transver of black or brown spots on the dorsum. Cornicles black, slightly longer than their apices slightly enlarged. Cauda rounded, concolorous with the body, marginal fringe of hairs. Front of head bears four short hairs. Legs gree greyish tinge, tarsi and tibial apices black. Beak pale, reaching second coxae

Measurements:	Body, length	3.50 mm	Antennal joints	I
	" width	1.21 mm		II
	Cornicles	.107mm		III
	Cauda	.087mm		IV
				V
				VI
				fil.

Male. Not taken.

The sexual female is abundant on cultivated Birch in November Locality, Oakland, Cal.

Euceraphis flava sp. nov. (Figs. 6, 7).

Alate viviparous female. Pale yellow, covered with greyish-white woolly secre Antennæ one-fifth longer than the body, mounted on frontal tubercles; joint 1 joint 2 in length and half as wide again; joint 3 much the longest, almost equ 4 and 5 combined; joint 5 a little shorter than 4 and twice as long as 6; the fila four-sevenths as long as joint 6. First two joints encircled with a broken black at about half their lengths. Articulations of other joints black. Sensoria distrib as follows:—joint 3, 5–7, oval, transverse sensoria on its proximal fifth; joint 5 apical sensorium; joint 6, 1 large apical sensorium and 3 smaller ones. Head ocelli pale yellow. Eyes dark red. Prothorax pale with two parallel longitudinal stripes, one on either side of the dorso-median area. Thoracic lobes and scutell pale brown, the latter with a black posterior border. Wings of medium size, st narrow, extended, pale grey; veins narrow, brown; sub-costa pale grey. L long, thin, pale yellow; tibiæ dark brown at the base and apex; tarsi dark br Abdomen long and narrow, with three pairs of tubercles on its anterior half, one on each of the segments 2–4 inclusive. These tubercles are dark brown, wa directed latero-caudad. Cornicles dark brown, as broad at the base as long, sit on a semicircular brownish area. Seventh segment with a pair of smaller lateral tubercles. Posterior margin of segment 8 with a brown cross Cauda short, pale, globular. General color of the abdomen light yellow. pale, tip brown, extending a little beyond the first coxae. Lower side of body yellow.

Measurements:	Body, length	3.33mm	Antennal joints	I
	" width	1.18mm		II
	Wing expanse	8.64mm		III
	Cornicles	.07mm		IV
				V
				VI
				fil.

[illegible]pa of alate female. Pale yellow, with no woolly secretion. Antennal annulation and tarsi black. Rest of body pale yellow with the exception of abdominal dusky spots arranged as follows: two median dorsal and two lateral on segments 1 5 to 7, two median dorsal on segment 6 (on which occur the cornicles). The dusky spots are tuberculate and bear capitate hairs.

This species is not uncommon on the under side of the leaves of *Rubus rhombifolia* Nutt. I have never seen the apterous female nor the sexual forms. Habitat: Santa Clara Co., Cal. Spring and Summer.

Aphis cardui L.

Colonies on the young growth of several thistles throughout summer. Habitat; San José, Cal.

Aphis atriplicis L. (Figs. 8, 9).

Apterous male. Head, thoracic lobes and scutellum black. Prothorax brown. Eyes dark red. Antennae black, reaching to the cornicles, third joint the longest, filament next, then fourth, fifth, sixth, first and second in order. Frontal tubercles small, black. Lateral tubercles absent. Legs brown, hind pair darker. Abdomen pale yellow, with 8 brown dorsal transverse bars, which are often broken up into spots. Cornicles short, black, incrassate, not half as long as the hind tarsi. Cauda black, tapering to a blunt apex, half as long again as the cornicles. Genital segment below cauda large, black, rounded. Coxae, under side of head and thorax and genital segment black. Rest of lower surface yellow. Beak transparent, its tip black, reaching second coxae. Sensoria on antennal III 18 21; IV 7 9, V 6 8, VI 3 5, small, placed irregularly on the much serrated antennae.

Measurements;	Body, length	1.08mm	Antennal joints	I	057
	" width	.46mm		II	050
	Cornicles	.078mm		III	.300
	Cauda	.086mm		IV	151
				V	185
				VI	121
				fil.	257

Oviparous female. Entirely pale greenish-yellow, with a thin white powdery covering. Eyes red. Antennae seven-jointed, about one-third the length of the body, pale greenish-yellow; the relative size of the joints as follows: joint III longest; the filament or seventh joint a little shorter with IV; V and VI sub-equal. Legs pale greenish-yellow, coxae brown. Cornicles pale brown, almost as long as the hind tarsi. Cauda shaped as in the male, pale brown, slightly exceeding the cornicles in length. Anal segment brown. Beak not quite reaching second coxae, pale brown.

Measurements;	Body, length	1.57mm	Antennal joints	I	054
	" width	.77mm		II	043
	Cornicles	1.07mm		III	179
	Cauda	1.30mm		IV	086
				V	065
				VI	088
				fil.	133

Apterous viviparous female. Pale green, slightly pulverulent. Body more than [illegible] as long as wide. Antennae dusky, a little over one-third the body in length;

joint III the longest, filament next, then joint IV and V sub-equal, then VI. L
Legs entirely dusky brown. Cornicles green, slightly incrassate, small, barely e
ing the fore tarsi in length. Cauda slightly dusky, a little longer than the ro
widest at the base, tapering gently to a blunt apex. Eyes dark red. Beak o
very short, reaching midway between first and second coxae. Coxae very dark.

Measurements:			
Body, length	1.82mm	Antennal joints	I
" width	.83mm		II
Cornicles	.147mm		III
Cauda	.226mm		IV
			V
			VI
			fil.

Occurs on the upper side of the leaves of *Chenopodium murale* the sexual forms appearing in August. Habitat; San José, Cal.

Aphis salicicola Thos.

Abundant on Willows throughout the summer. Preyed on by the larva of a *Leucopis* (Agromyzidae). Habitat; San José, Cal.

Aphis maidis Fitch.

Colonizing Corn (*Zea mays*). Habitat; San José, Cal.

Amphorophora latysiphon sp. nov. (Figs. 10-13.)

Alate viviparous female. General color dark olive green. Head, prothor thoracic lobes, scutellum, frontal tubercles, first two joints of the antennae, cornicles and cauda black. Legs yellowish-brown; distal half of the femora, distal third of the tibiae and the tarsi darker. Eyes dark crimson lake. Antennae on frontal tubercles, which bear hairs on their inner angles, half as long again as the body, armed with many hairs; third joint the longest, joints 4 and the filament sub-equal, joints 6 and 1 sub-equal, joint 5 a little shorter than joint 4. Sensoria distributed as follows: joint 3, 13-17 on the exterior margin in an irregular row; joint 5, 1 apical; joint 6, 1 large and 3 small, all apical. General color of antennae yellowish-brown. Later tubercles small, bearing a hair. Wings of medium size, veins brown, stigma and color colored, second fork of third discoidal close to the wing apex. Abdomen oval, yellowish-green or dark olive, with a large sub-quadrate black spot on the dorsum above the cornicles and a black cross-band on the segment below the cornicles and lateral spots. Cornicles long, very much dilated for half their length. Cauda ensiform, about one-third the length of the cornicles. Under side of the body and beak olive green; tip of beak and sterna black. Beak reaches second coxae. Coxae dusky.

Measurements:			
Body, length	2.54mm	Antennal joints	I
" width	1.17mm		II
Wing expanse	8.75mm		III
Cornicles	.67mm x .157mm		IV
Cauda	.19mm		V
			VI
			fil.

Apterous viviparous female. General color of the body light olive green. E dark red. Antennal articulations, prothorax, cauda, and a large quadrate spo the dorsum of the abdomen dusky to black. Cornicles black. Antennae on h

frontal tubercles, longer than the body with the relative size of the joints as in the winged form. Legs light olive, apical half of femora, tibial apices and tarsi dusky to black. Cornicles and cauda shaped as in the winged form. Beak pale, tip black, reaching to second coxae.

Measurements:-			Antennal joints		
Body, length	2.57mm		I		.040
" width	1.14mm		II		.067
Cornicles	.73mm x .10mm.		III		.887
Cauda	.18mm		IV		.081
			V		.004
			VI		.151
			fil		.100

Occurs sparingly on the Periwinkle *Vinca major* and *Convolvulus arvensis*. Habitat: San José and Courtland, Cal.

Pterodon carduinum Walker.

On the under side of the leaves of Artichoke, becoming a pest. Very susceptible in California to fungus diseases. Kindly determined by Mr. J. T. Monell. Habitat: San José, Oakland and Courtland, Cal.

Myzus varians sp. nov. (Figs. 14–19.)

Pupa of alate female oviviparous, dark form. Pale yellow, prothorax, anterior half of the abdomen, 7th abdominal segment purplish-red. Head pale yellow, ocelli prominent, light red. Eyes dark red. Antennae on large frontal tubercle reaching to the base of the cornicles, pale yellow; articulations of joints 3–6 and the filament black. Filament the longest joint, then 3, 5, 4, 6, 1, 2 in the order. Legs pale yellow, tarsi black. Sutures of thoracic lobes reddish, wing pads pale with dusky tips. Abdomen broadest at the fourth segment, then tapering abruptly to the cauda. Cornicles about as long as antennal joints 4 and 5 together, narrowing from the base and curved, pale with the tip black. Cauda almost cylindrical, conical, as long as the hind tarsi. Beak pale, tip black, reaching the second coxae. Under side of the abdomen and thorax more or less reddish.

Measurements:-Body, length 1.73mm
" width .72mm

Alate viviparous female, dark form. Pale greenish-blue, first three and last two abdominal segments tinged with crimson (fainter in some individuals). Rest of abdomen with a faint bluish tinge. Head and antennae black. Eyes dark red. Frontal tubercles prominent. Antennae exceeding the tip of the abdomen, base of third joint pale; relative sizes of the joints as in the pupa. Prothorax brownish-red. Thoracic lobes and scutellum deep brown. Wings large; subcostal and radius reddish-grey; stigma long, narrow, grey; veins narrow, grey, second fork of the radius or third discoidal slightly nearer to first fork than to the wing apex. Legs yellowish-red, apical half of femora, tarsi, and tibial apices black. Abdomen widest at segment three, with dusky transverse bands which sometimes coalesce to form a quadrilateral area on the dorsum, and with black lateral spots, and with a transverse dusky bar below the cornicles. Cornicles dusky, slightly curved, rather tumid at the apex, not quite as long as antennal joint 3 and not quite reaching the tip of the cauda. Cauda black, conical, upturned, equalling the hind tarsi in length.

Under side of thorax black, of abdomen reddish. Beak pale, reaching n... between first and second coxae. Sensoria distributed as follows;—joint 3 ... circular, in an irregular row; joint 5, 1 terminal; joint 6, 1 large and 3 ... terminal.

Measurements;—			Antennal joints	
	Body, length,	2.28 mm		I
	" width	1.05 mm		II
	Wing expanse	7.16 mm		III
	Cornicles	.407 mm		IV
				V
				VI
				fil.

Alate viviparous female (Light form). Pea green. Antennae on prom... frontal tubercles, longer than the body, black with joints 1 and 2 green and j... 4 and 5 light brown. Eyes dark red. Head and prothorax light brown, re... the body green. Abdomen wider than the thorax, widest at the fourth segm... Wings large; stigma greyish-yellow, narrow and long; insertions and sub-c... greenish-yellow; second fork of third discoidal about midway between first ... and the wing apex. Legs green, knees, tarsi and tibial apices black; tibiae yel... ish. Cornicles green, slightly curved, six times the hind tarsi in length, shapel... in the dark form. Cauda short, dusky, conical. Beak green, tip brown, ... quite reaching second coxae. In the single specimen that I have there are 9 senso... on joint 3 of the left antenna and 10 on joint 3 of the right antenna. Joint 5 ha... terminal sensorium and joint 6, 4 terminal sensoria. The antennae of this form di... from those of the dark form by having joint 4 longer than 5.

Measurements;-			Antennal joints	
	Body, length	2.30mm		I
	" width	1.01mm		II
	Wing expanse	7.13mm		III
	Cornicles	.57mm		IV
				V
				VI
				fil.

Apterous viviparous female. General color pea green. Filament and articulati... of the antennal joints black. Mouth of the cornicles black. Eyes red. Tarsi g... Antennae on very conspicuous toothed frontal tubercles, reaching to the base of ... cornicles. Relative lengths of the antennal joints as in the green winged form. L... slender, green; all tarsi grey. Cornicles green, curved, with tip black, five or ... times the hind tarsi in length. Cauda green, conical, half as long again as the h... tarsi. Beak green, with a brown tip and extending to the second coxae.

Measurements;-			Antennal joints	
	Body, length	1.96mm		I
	" width	1.51mm		II
	Cornicles	.44mm		III
				IV
				V
				VI
				fil.

Occurs on the under side of the leaves of wild Clematis (*Cl... ligusticifolia* Nutt.). The alate green forms are very rare while

alate forms apparently do not appear until November. No sexual forms were collected. Habitat; San José, Cal.

Aphorophora rubi Kalt.

Colonizes the terminal shoots of cultivated blackberry and loganberry and is also to be found on the wild thimble-berry (*Rubus nutkanus* Moc.). I am indebted to Mr. J. T. Monell for the determination of this species. Habitat; San José, Cal.

Macrosiphum chrysanthemi Oestl.

On the young shoots of a composite. Habitat; Courtland, Cal.

Macrosiphum granarium Kalt.

Occurs on various grasses in spring. Habitat; San José, Cal.

Macrosiphum solanifolii Ashm.

Occurs on wild lettuce. Habitat; San José, Cal. I am indebted to Miss E. Patch for the identification of this species.

Explanation of Plates 11, 12: 1, *Calaphis betulaecolens*, alate male; 2, *C. betulaecolens*, viviparous female; 3, *Calaphis castaneae*, alate male; 4, *C. castaneae*, oviparous female; 5, *Lachnus betulae*, oviparous female; 6, *Euceraphis flava*, alate viviparous female; 7, head and antenna; 7, *E. flava*, abdomen; 8, *Aphis atriplicis*, alate male; 9, antenna of same enlarged; 10, *Amphorophora latysiphon*, head; 11, antenna; 12, cornicle; 13, cauda; 14, *Myzus varians*, head of alate viviparous female, dark form; 15, antenna of same; 16, cornicle of same; 17, head of apterous viviparous female; 18, antenna of same; 19, cornicle of same. I am indebted for these figures to Miss E. Weber, formerly in the employ of the Bureau of Entomology.

Locust Leaf Miner (*Chalepus dorsalis* Thunb.). This common enemy of the honey locust was excessively abundant on Long Island in 1911, the beetles, in association with the rosy hispa, *C. nervosa* Panz., skeletonizing the foliage of young honey locust trees over extended areas in the vicinity of Syosset. A recurrence of the attack was observed in August 1912, the injury being confined as previously largely to smaller trees and, the past season, being due almost entirely to work by *C. dorsalis*. The mines made by the grubs were of comparatively little importance but the feeding of the adults in August resulted in skeletonizing the foliage over large areas, the beetles being so numerous that 2, 4, 6 and even 8 were found on individual leaflets. It is evident that a thorough spraying, the latter part of July or early in August, with arsenate of lead would effectually control outbreaks of the beetle.

E. P. FELT

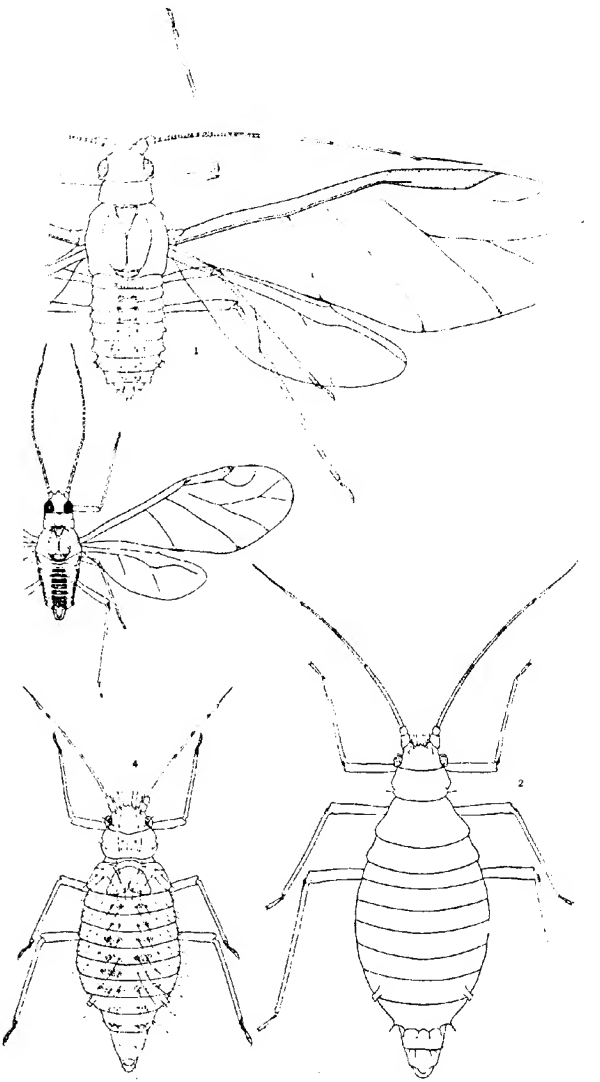
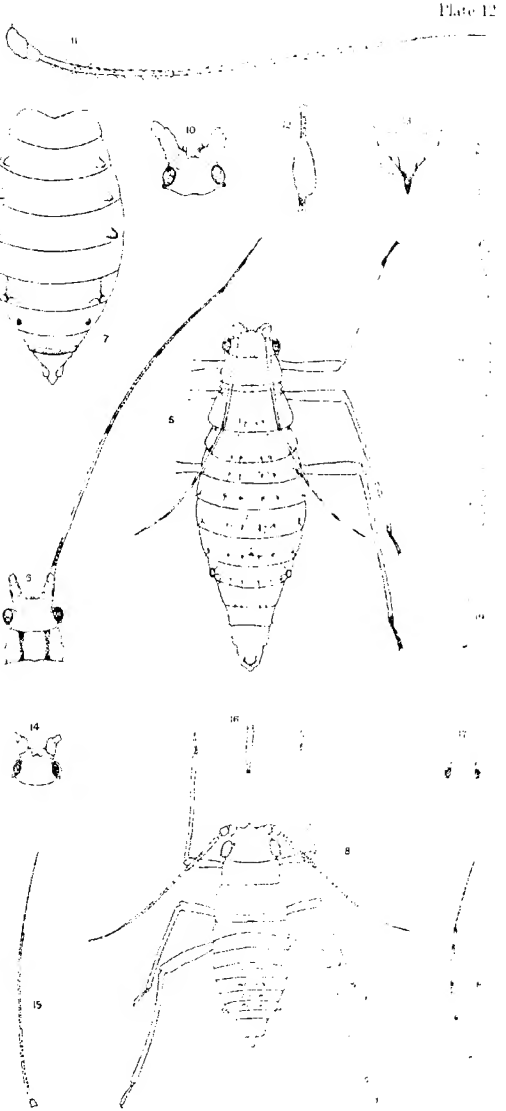


Plate 12



THE OCCURRENCE OF THE CITRUS RED SPIDER, TETRANYCHUS MYTILASPIDIS RILEY, ON STONE AND POMACEOUS FRUIT TREES IN OREGON

By H. E. Ewing, *Agricultural Experiment Station, Corvallis, Ore.*

In November of last year, while examining some leaves and twigs of apple trees at Corvallis for the common red spider of our eastern states and of Europe, *Tetranychus telarius* L., I came across another species which could easily be distinguished from *T. telarius* L. by the use of my hand lens. Upon examining specimens with the compound microscope in the laboratory, I was much surprised to find that the species was no other than *Tetranychus mytilaspidis* Riley, the well-known red spider of citrus trees in southern California. Since this initial observation several records have been made of this species in Oregon. The writer submits the following notes on its biology and economy under the influences of its new host plants and new climatic conditions.

In the autumn when the leaves of the deciduous fruit trees begin to brown, die, and fall, these mites change their summer habit of depositing eggs upon the leaves of the trees, and deposit nearly all of them on the twigs. After egg deposition the adults fall to the ground with the leaves and die. These eggs are always deposited singly, and may be placed very close together so that at times scores or even hundreds will be found almost touching one another. They are laid preferably at the bases of the last year's shoots or around the bases of the fruit spurs. Here they frequently become so numerous as to make these portions of the twig look quite red.

The eggs remain on the twigs over winter, and in Oregon suffer little from the hardships of moisture or low temperature, and are, at present, remarkably free from the attacks of predaceous enemies. During the month of April the eggs hatch, and the newly emerged six-legged larvæ run about hunting for the opening leaf buds or the first tender leaf shoots where at once they begin to feed. By the seventh of May, at Corvallis, I found all instars present, as I found from this time on until the end of the season. These mites continue to feed and reproduce from the time of hatching in April until the end of the rainy season but with very little vitality. So few individuals are present at this time of the year that they are completely overlooked by fruit growers.

It is during July that the decrease in the humidity and the general increase in temperature causes these mites to reproduce and feed with great vigor. Now the adults become very active, and eggs are found

scattered about all over the leaves. It is during this season that the species becomes very injurious to the trees by sapping the juices from the leaves and causing the latter to become pale or spotted and to curl up around the edges.

This species doubtless can be held in check by the use of summer sprays similar to those recommended for it in California; but, since the winter is passed only in the egg instar and these eggs are deposited in an exposed position, doubtless some dormant spray will be found that will be more satisfactory. I may add that lime-sulphur is not a satisfactory winter spray for the eggs of this mite. It will not kill the embryos in the eggs at all, but will, however, kill some, and at times perhaps 60 percent or 70 percent, of the larvæ after they have emerged.

The following records of the species in Oregon have been made and are here presented in tabular form:

RED SPIDER IN OREGON

Locality	Date	Host plant	Instars present	Situation and injury
Corvallis	Nov. 16	Apple	Chiefly adults and eggs	Adults on fallen leaves. Eggs on twigs
Salem	Dec. 19	Prune	Eggs	On twigs
Corvallis	Dec. 26	Apple	Eggs	On fallen leaves
Lane County	Feb. 11	Peach and prune	Eggs	At the base of the last season's growth of twig
Eugene	Feb. 16	Apple	Eggs	On bases of twigs and spurs
Corvallis	Feb. 24	Apple	Eggs	At bases of spurs and in rough places on twigs
Corvallis	March 19	Prune	Eggs	On twigs. Thickest at bases of spurs
Salem	March 20	Prune	Eggs	Slight infestation on twigs
Salem	March 20	Apple	Eggs	Bad infestation of twigs
Estacada	March 30	Apple	Eggs	On rough bark of twigs and at bases of spurs
Corvallis	May 7	Apple	All instars	On the under side of young leaves
Corvallis	May 18	Apple	Adults and eggs	On leaves causing little injury
Corvallis	July 20	Apple	Adults and eggs chiefly	Causing slight injury to leaves
Corvallis	July 23	Prune	All instars	Very few individuals present on some leaves, eggs numerous
McMinnville	July 25	Apple	All instars	No noticeable injury to leaves
Corvallis	Aug. 1	Apple	All instars	Injury slight
Corvallis	Aug. 17	Apple	All instars	Injury serious. [illegible] upward cupping of edge of leaves

THE LIFE HISTORY AND HABITS OF CHEYLETUS SEMINIVORUS PACKARD

By H. E. Ewing, *Agricultural Experiment Station, Corvallis, Oregon*

Frequently found associated with some of our insect and mite pests is a little predaceous acarid, pale in appearance and less than a millimeter in length. This species was first described by Professor A. S. Packard in 1869. Since then it frequently has been observed by entomologists, usually in stored grain or grain products. The scientific name of this mite is *Cheyletus seminivorus* Packard. The specific name, *seminivorus*, means seed devouring; and doubtless was given to the species because it was believed that the acarid lived upon seeds. At any rate, it was first found in stored cabbage seed. The species, however, is not an enemy to seeds of any kind or to stored grains, for it is entirely carnivorous. When it is found among seeds or in stored grain it should be protected in every way, for it is there only to prey upon some other species, which is the real pest, whose destruction is to be desired.

During the last winter the writer came into possession of a sample of milled wheat which was infested with millions of Tyroglyphid mites. Associated with these Tyroglyphids were found at first only a few individuals of *Cheyletus seminivorus* Pack. Some of these were selected to be used in a series of experiments upon the life history and habits of this species. The following results were obtained.

Life History

Number of Eggs Laid and Rate of Deposition. Of the three females which I succeeded in getting to deposit eggs, one laid a total of 25 in a period of 6 days; another 22 in a period of 2 days; while the third laid only a single egg. The greatest number of eggs laid in one day by a single female was 11. The average rate of deposition per day for a single female was 5 1-3. All the females lived for several days after egg deposition had ceased. The eggs were laid near each other, but not in clusters; and the female remained by them for some time after deposition had ceased.

Length of Incubation Period. Of the 48 eggs laid in captivity 32 hatched. The minimum incubation period found for any one egg was 3 days, the maximum was 7 days. The average period of incubation for the 32 eggs was 4.31 days. These eggs were kept in cells at ordinary laboratory temperature.

Description of Egg Instar. The egg is white, shiny, oblong-oval. It is about two and one-half as broad as long. Generally the eggs are more convex on one side than on the other. During development the buds for the appendages may be seen through the egg-shell. Just before emergence the completely formed larva may easily be seen through the egg's shell. The egg-shell is a thin resistant membrane which shrivels up after the hatching process. Measurements were made of 7 eggs which gave averages as follows: length, 0.130 mm.; breadth, 0.0.04 mm.

Percentage of Larvae Hatching from Eggs Deposited in Captivity. Of the eggs deposited in captivity 66 per cent. hatched. Those that did not hatch did not show developing embryos at any time, but soon began to shrivel and later to contract and dry up. I judged from this that they had not been fertilized.

Length of Larval Stadium. Of the 32 larvae which hatched from the eggs deposited I was able to get only 9 to live for any length of time. Yet out of these, 3 passed the larval instar into that of the first nymph. The minimum length of the larval stadium was 6 days, the maximum 9 days, the average 7.66 days.

Description of Larval Instar. Hyaline; in general appearance somewhat like the adult. None of the parts strongly chitinized. Beak very little chitinized. Palpal claw similar to that of the adult, but without the two tooth-like tubercles at its base. Inner serrula of palpal papilla about four-fifths as long as the outer and without teeth, being simply a large, curved bristle; outer serrula much stouter than inner, number of teeth 6 or 7. Antepenultimate segment as broad as long; femur of palpus but little swollen. Abdomen scarcely as large as cephalothorax. Three pairs of legs present. Measurements were made of three individuals which gave the following averages: length, 0.192mm.; breadth, 0.096mm.

The larva may at once be distinguished from the nymphs and adult by having only three pairs of legs instead of four as is found in the latter stages.

Length of First Nymphal Stadium. Two of the three nymphs passed this stadium successfully and became second nymphs. The length of the first nymphal stadium was in one instance 4 days, in the other 5 days. The other first nymph was killed in order to make a permanent mounted specimen of this instar.

Description of First Nymphal Instar. In general appearances this nymph is similar to the adult, but lacks certain structures while other structures which are found in the adult, in the first nymph have different proportions. Body and appendages, except the beak fleshy, soft, hyaline; tip of beak somewhat chitinized. Beak quite noticeably shorter in proportion to the body than in the adult. Palpal claw as in the adult except the two tubercles at its inner side at the base are wanting. Outer serrula of palpal papilla with only 6 or 7 teeth; inner serrula without teeth, being simply a large, stout, curved, tactile seta; curved tactile seta of papilla as in adult. Antepenultimate segment and femur of palpus as in adult. Antennæ peculiar in relatively, much shorter in the first nymph than in the adult; tactile bristle of each as long as the segment itself. Last pair of legs extending beyond the tips of the abdomen by one half their length. Total length of body, including the beak, 0.42mm.; width, 0.16mm.

Length of Second Nymphal Stadium. Of the two second nym... obtained, one transformed in five days into the adult; the o... strange to say, lived in its cell for 32 days without transforma... At the end of this time it accidentally escaped. During this pe... it frequently became quiescent but at no time did it und... transformation.

Description of Second Nymphal Instar. Very similar to the adult; beak and ... showing more chitinization than in the first nymph. Beak and palpi very simil... that of the adult. Palpi stout, extending beyond the tip of the beak by abou... fifths their length. Outer serrula of palpal papilla relatively larger compared to ... palpal claw than it is in the adult, with 12 teeth; inner serrula with teeth, whi... it differs from that of the first nymph; number of teeth less than that of the ad... being only 9 or 10; curved tactile seta as in adult. Anterior pair of legs shor... than the body exclusive of the beak; tarsus considerably longer than the tibia ... true of the adult. Second pair of legs two thirds as long as the first pair; fourth p... of legs extending beyond the tip of the abdomen by one half their length. To... length of the body, including the beak, 48mm.; width, 0.26mm.

Length of Adult Stadium. The single adult obtained lived for 1... days and then died a natural death. This period corresponds very w... with the length of time some of the adults lived which were not reare... from eggs deposited in captivity.

Description of Adult. A very light yellow, almost flesh color; palpi and beak darker than the body and legs. Beak as long as the rest of the cephalothorax, more strongly chitinized at its tip than at its base and bearing not far from its tip a small pair of hairs or setae which extend one half their length beyond the beak. Palpi very stout, extending beyond the tip of the beak by two fifths their length. Last segment of palpus ending in a stout, curved, simple claw which extends beyond the tip of the outer serrula of palpal papilla by about one fourth its length. Two spur-like tubercles of about equal size are situated on the inner margin of the segment at the base of the palpal claw. Palpal papilla, or thumb, short, stout, as broad as long, bearing two serrulae and a large, curved, tactile seta; outer serrula much larger than the inner and almost as long as the palpal claw, with from 12 to 15 teeth, which increase in length as you pass from the base to the tip; inner serrula slightly over half as long as the outer, with from 14 to 16 teeth, which are longest from the middle of the organ and become shorter as you pass toward the tip or base; curved tactile seta longer than the outer serrula and situated between and slightly below the two serrulae. Antepenultimate segment almost as broad as long; with but two setae which, however, are prominent; one is a large, curved, tactile seta situated on the inner margin of the segment next to the papilla, it is longer than the palpal claw; the other seta situated on the ventral side of the segment. Femur of palpus one and a half times as long as broad; inner margin concave, outer margin convex. On the upper side of the femur of the palpus is situated, a very long, simple or slightly pectinated bristle which is slightly longer than the segment itself. No other bristles on the upper face of this segment. Cephalothorax broader than long excluding the beak. Eyes absent. Anterior pair of legs slightly longer than the body excluding the beak; tactile hairs on the tarsus sub-equal, and slightly shorter than the tarsus itself; tarsus longer than the tibia. Posterior pair of legs extending for almost one half their le...

beyond the tip of the abdomen. Total length of body excluding the beak, 0.58 mm.; width, .025mm.

Habits

The Molting Process. I was unable to observe the actual process of molting, but an examination of the cast skins showed that they had been split transversely at or near the scapular groove. This rupture was sometimes complete, and the two parts of the old skin when cast remained separated from each other some distance. The process evidently is the same for all stages. In some instances the posterior part of the cast skin showed a lateral rupture passing backward from the transverse one.

Nature of Food. This species is entirely carnivorous in its diet, and much prefers to catch its prey. Young individuals prefer to live upon the eggs of other mites if they can obtain them, and individuals of all stages will suck the juices of freshly killed creatures if they are unable to catch live ones.

Method of Approach and Attack upon Prey. These predaceous mites are extremely cautious about attacking creatures even smaller than themselves. I have watched the process several times upon the stage of the microscope. An individual will first approach its suspected prey slowly and touch it with the long tactile hairs on its front legs. Then it will retreat. Again it will repeat the process from another direction and again retreat. Now the hind legs will be presented to the victim and again a retreat will be made. When several of these actions have been performed and apparently if the Cheyletus has decided that it has prey and not a dangerous enemy, it rushes upon the latter and seizes it at the nearest point of attack by means of its powerful palpi, inserts the beak, and begins to suck the juices.

The Feeding Process. The victims do not stop movement when seized by this mite, as is claimed to be true by some writers for species of Cheyletus; in fact, frequently they are not killed at all. If the Cheyletus has been fasting it will seize its victim and suck it dry. I observed one under such conditions, and it took just 13 minutes for the feeding process.

After the beak is inserted one can see the strong pharyngeal muscles contract and relax very rapidly, while the stomach and abdomen gradually become distended with the blood sucked from the victim.

Number of Victims Killed. The adult individuals of *Cheyletus eruditus* will frequently attack and kill many of their victims and suck but little of the blood. When they are very hungry they suck their victims dry, but if plenty of food is at hand they do not suck them

dry. A single female in captivity killed 17 out of 20 Tyroglyp[illegible] mites in a day. Hence it will be seen that even in the adult st[illegible] alone, a great number of victims will be killed under favorable co[illegible] tions, perhaps scores or even hundreds, by a single Cheyletid.

The Value of the Predaceous Habit as a Check upon the Ravages of Certain Pernicious Mites

Several entomologists have noticed the value of this species and others of the same genus in holding in check mite enemies of stored grain. Just how effective it is may be learned from the following: When the writer received the sample of milled wheat infested with millions of cheese mites (*Tyroglyphus* sp.) a careful examination of the same revealed but a few individuals of *Cheyletus seminivorus* Pack. Among the myriads of Tyroglyphids which swarmed in the ground grain scarcely any dead ones could be found. A short time after then I examined the same sample and found that out of 100 Tyroglyphids counted, 95 were dead and shriveled, 1 was dead but not shriveled, and only 4 were alive and active. Now the Cheyletids were common and everywhere busy seizing the Tyroglyphids and sucking their juices. Thus in a short period of only a few days this predaceous species had multiplied and destroyed about 95 per cent of the pernicious Tyroglyphids.

FEDERAL QUARANTINE NOTICES

Mediterranean Fruit Fly (*Ceratitis capitata* Wied.) Under authority of the Plant Quarantine Act, Acting Secretary of Agriculture, Willet M. Hays has declared a quarantine against the following fruits grown or shipped from the territory of Hawaii: Alligator pears, Carambolas, Chinese ink berry, Chinese orange, Chinese plums, Coffee berries, Damson plum, Eugenias, Figs, Grapes, Grapefruit, Guava peppers, Guavas, Kamaai seeds, Kumquats, Limes, Loquats, Mangos, Mock orange, Mountain apple, Natal or Kaffir plum, Oranges, Papaya, Peaches, Persimmons, Prickly pears, Rose apple, Star apple, String beans, and Tomatoes.

Potato Wart (*Chrysophlyctis endobiotica* Schilb.) Quarantine has likewise been declared against potato wart, potato canker, black scab etc. and the importation of potatoes forbidden from the following countries: Newfoundland, the islands of St. Pierre and Miquelon; Great Britain, including England, Scotland, Wales and Ireland; Germany; and Austria-Hungary.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged. EDS.

The recent enactment of a National Plant Quarantine Act is a great stride in applied or economic entomology and one which should have been taken years ago. The Federal Government is now charged with functions which could not be exercised by the various States and all may look for a much greater protection from injurious insects. Co-operation between National and State agencies should result in a maximum efficiency at a minimum expenditure. Some were afraid such a law might prove a serious hindrance to certain phases of the nursery business. There is no denying that the welfare of all should take precedence over the prosperity of a few. Nevertheless, the administration of this law will doubtless go far to prove the groundless character of these fears and show how the enactment can be interpreted in such a catholic spirit as to command the respect of all.

The campaign against the house or typhoid fly has been in progress for about a decade. The press has displayed a commendable interest, many dailies and weeklies publishing brief timely warnings or directions for controlling the fly. We have at least two volumes on this insect, a moving picture film, some local anti-fly ordinances, accompanied here and there by vigorous campaigns and flies. This is no implication that conditions have not bettered in some localities. It is simply an invitation to pause and see what has been accomplished. The educational campaign has been a necessary prelude to activity and here and there, but only locally, have we seen an approach to a systematic attempt to control this familiar pest. Is it not time that the more progressive sentiment of many communities, not excluding States, was crystallized into ordinances and laws along the lines such as those suggested by the Indiana State Board of Health for city and villages? Most intelligent people accept in a placid manner the statements respecting the dangerous character of the fly, but in comparatively few instances does this result in action. Furthermore it is difficult to secure desirable activity so long as neighbors do not or can not be compelled to assist in an undertaking which must depend in large measure for success upon general adoption. Here is where

ordinances and laws are useful. Entomologists and others inter... in bettering sanitary conditions might well turn their attention ... this phase of the problem, since even the possibility of coercion pro... a powerful stimulant to many who would otherwise be indifferen...

Reviews

Elementary Entomology, by E. DWIGHT SANDERSON and C. F. JACKSON, pages 372, figures 496. 1912.

The volume under consideration may be characterized as an excellent, profusely illustrated elementary entomology, admirably adapted to the needs of those interested or likely to become interested in the elementary or economic phases of the Science.

With less than 400 pages and nearly 500 text illustrations, the need of condensation is evident. Some 35 pages are devoted to a discussion of the external and internal anatomy, 22 pages illustrate growth and transformations, while over half the volume, about 200 pages, outline briefly the salient characteristics of the more important groups and incidentally notice many injurious forms. Scattered throughout the work there is much biological information, the value of the latter being greatly enhanced by the numerous figures of early stages in connection with those of the adult insect.

The laboratory work provides for the anatomical study and comparison of several typical forms and for biological work with aphids, the cabbage butterfly and the fruit fly. The keys to the orders and the more important families make it possible for students using this volume to become well acquainted with the entire group.

The authors have been successful in producing an admirable volume, small in size and moderate in price, which will appeal strongly to all having charge of elementary students in entomology. The paper is excellent, the printing clear, the figures distinct and the general appearance of the work most attractive.

The Wheat-Head Army-Worm as a Timothy Pest, by R. L. WEBSTER, Iowa Agricultural Experiment Station, Bulletin 122, pages 323-348. 1911.

The author gives an excellent comprehensive account of a timothy pest, *Meliana albilinea*. The discussion of control measures immediately following the characterization of the injury is a commendable feature in popular bulletins. The author advises clean culture, fall plowing and early fall pasturing. There is an excellent bibliography, a full life history and concise descriptions of the various larval stages. The excellent paper brings out the illustrations in a very satisfactory manner.

White pine blister rust (*Peridermium strobi* Kleb.) Under authority of the Plant Quarantine Act, Acting Secretary of Agriculture, Willet M. Hays has declared a quarantine against the following pines and their horticultural varieties, viz.: White pine (*Pinus strobus*), western white pine (*Pinus monticola*), sugar pine (*Pinus lambertiana*) and the stone or cembrian pine (*Pinus cembra*) originating in the following countries: Great Britain, France, Belgium, Holland, Denmark, Norway, Sweden, Russia, Germany, Austria, Switzerland and Italy.

Current Notes

Conducted by the Associate Editor

Professor S. W. Williston will make a paleontological expedition to South Africa this fall.

Mr. C. S. Brimley of Raleigh, N. C., has been elected president of the North Carolina Academy of Science.

Dr. J. S. Ward has been appointed inspector of Apiaries for the State of Tennessee, with headquarters at Nashville.

Mr. W. J. Price is now acting State Entomologist of Virginia, in place of Dr. E. A. Back who has resigned, to take up work in the Bureau of Entomology.

Mr. B. H. Walden, Assistant in Entomology at the Connecticut Agricultural Experiment Station, spent his vacation in Western Ontario, Can.

According to the report of G. M. Bentley, State Entomologist of Tennessee, there are 365 nurseries in Tennessee, with an annual income of $3,000,000.

Chas. T. Greene, Philadelphia, Pa., is now assistant in the Division of Forest Insect Investigations of the Bureau of Entomology. His specialty is Diptera.

Professor John Craig, professor of Horticulture in Cornell University and Editor of the National Nurseryman, died August 12th, at Stasconset, Mass., aged 48 years.

According to *Science* a valuable collection of British Lepidoptera made by the late John A. Finzi, has been presented by his widow and daughter, to the Zoological Museum at University College, London.

Professor F. W. Rane was appointed by Governor Foss of Massachusetts a delegate to the Second International Congress of Entomology at Oxford, England, held last August.

H. Maxwell Lefroy, Entomologist to the Government of India, located at Calcutta, has been appointed Professor of Entomology at the Imperial College of Science and Technology, South Kensington, London.

When Professor A. J. Cook became Commissioner of Horticulture in California a new publication called "The Monthly Bulletin" was started. The eight numbers issued have been issued, making altogether 707 pages of interesting and valuable matter.

Mr. Howard Evarts Weed, a member of this association, formerly Entomologist of the Mississippi Agricultural Experiment Station, and now a landscape architect at Chicago, is the author of a book entitled "Modern Park Cemeteries," published by Rand, McNally & Co., Chicago.

Mr. F. W. L. Sladen F. E. S., formerly of Ripple Court Apiary near Dover, England, has been appointed assistant in Apiculture at the Experimental Farms, Ottawa, Can. Mr. Sladen is a practical beekeeper as well as a student of entomology and his work will be under the Dominion Entomologist, Dr. C. Gordon Hewitt.

Dr. W. J. Holland, Director of the Carnegie Museum, Pittsburgh, Pa., Aut... "The Butterfly Book" and "The Moth Book" sailed August 20th, for Buenos ... to install in the National Museum at La Plata, a replica of *Diplodocus ca...* presented by Mr. Carnegie.

Mr. W. S. Fisher, for sometime assistant in the Division of Economic Zo... Harrisburg, Pa., has recently accepted a position under Dr. A. D. Hopkins, ... Division of Forest Insect Investigations, Bureau of Entomology. Mr. Fisher spe... izes in the order Coleoptera, and for a time he will be stationed at Charter Oak, ... but during the winter will be located at Washington.

Professor T. J. Headlee of the Kansas Agricultural College has been appo... Entomologist of the Agricultural Experiment Station, State Entomologist of N... Jersey, and Professor of Entomology at Rutger's College, New Brunswick, N. J. ... successor to the late Dr. John B. Smith. Professor Headlee planned to take up ... new work about October 1st.

According to *Science* Dr. Henry Fox, professor of biology at Ursinus College, ... resigned to accept a position as assistant in the Bureau of Entomology. For the ... present his headquarters will be at the Experiment Station, Lafayette, Ind.

Rev. Geo. W. Taylor, a collector and writer in entomology, especially Lepidoptera, ... died at his home near Nanaimo, B. C., August 22. Mr. Taylor was Curator of ... the Canadian Marine Biological Station at Departure Bay.

It is reported in *Science* that a collection of foreign Lepidoptera containing about ... 150,000 specimens, included in 68 cabinets and worth over $200,000 has been ... received at the British Museum as a bequest from the late Mr. H. T. Adams of ... Enfield.

According to the Monthly Bulletin of the California State Commission of Horti... culture, the services of Dr. F. Silvestri of Portici, Italy, have been procured for a ... period of twelve months, by the Board of Agriculture and Forestry of Hawaii, for the ... purpose of introducing into the Hawaiian Islands, parasites of the Mediterranean Fruit ... Fly, *Ceratitis capitata*, and the local Cotton Boll Worm, *Gelechia gossypiella*. Dr. ... Silvestri will obtain a leave of absence from his present work, and at an early date will ... visit the tropical portion of West Africa for this purpose. A series of Entomological ... Stations for receiving and distributing parasitic material will soon be established.

Mr. C. H. T. Townsend removed with his family in June, 1912, from Piura to Lima, ... Peru, where he becomes chief of the Estacion de Entomologia now being established ... with headquarters at the capital. The work at Piura will constitute a branch of the ... station. Mr. E. W. Rust, who has charge of the work in Piura under Mr. Townsend, ... was unharmed by the severe earthquake which visited that region on the morning of ... July 24, 1912. The collections, books, notes and important equipment escaped the ... earthquake, having been transferred to Lima. The Piura office quarters were badly ... damaged and a transfer is being made to a new temporary site. The equipment left ... in Piura suffered only nominal damage. Mr. Townsend's correspondents will please ... note his change of address to Estacion de Entomologia, Lima, Peru.

The following have been appointed members of the Federal Horticultural Board ... to have charge of the administration of the Plant Quarantine Act; Dr. C. L. Marlatt, ... Assistant Chief, Bureau of Entomology (Chairman); Dr. W. A. Orton, Plant Pathologist (Vice-Chairman), Peter Bisset, of the Bureau of Plant Industry; A. ... Burgess of the Bureau of Entomology and George B. Sudworth of the Forest Ser...

Mailed October 15, 1912.

TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Cleveland, Ohio, January 1–3, 1913.

The twenty-fifth annual meeting of the American Association of Economic Entomologists will be held in Cleveland, Ohio, January 1–3, 1913, in the Normal School Building, which is located between Euclid Avenue and East 107th and 115th Streets, four miles east of the center of the city.

The opening session will be called to order at 1 p. m., Wednesday, January 1, when the address of the President of the Association will be delivered. The meeting will be continued Thursday, in the morning and afternoon, and the final session will be held at 10 a. m., Friday, January 3.

Other Meetings

The American Association for the Advancement of Science, and its affiliated societies will hold meetings throughout the week. The Entomological Society of America will meet on Tuesday, December 31, and on Wednesday morning. The public lecture before that Society will be delivered Wednesday evening by Dr. P. P. Calvert of Philadelphia, Pa. The American Association of Official Horticultural Inspectors will meet Thursday evening at 8 p. m., when the Presidential address will be given. The meeting will be continued to Friday afternoon and evening.

Hotel Headquarters

The hotel headquarters for this Association have been secured at Hotel Euclid, which is located at Euclid Avenue, 14th and Huron Streets, in the central part of the city. Rates ranging from $1.50 per day and up for single rooms have been secured on the European plan. Members are urged to make hotel reservations as soon as possible as the number of rooms available at the lower rate are limited.

Railroad Rates

The following information concerning railroad rates has been furnished by Dr. L. O. Howard, permanent secretary of the American Association for the Advancement of Science:

Cleveland is in the territory of the Central Passenger Association. Legislative acts having reduced fares in this territory to the two cents a mile basis, the Central Passenger Association cannot make a further reduction by authorizing the certificate plan of fare-and-three-fifths for the round trip. This means that the certificate plan does not apply for this meeting. It is suggested that advantage be taken of such excursion fares as may be in effect at the time of the meeting. Members should, therefore, consult their local ticket agents regarding routes and rates. Parlor and sleeping car accommodations should be reserved in advance.

From the States of California, Nevada, Oregon, Washington, and west of, and including, Mission Junction, B. C.; also from what are known as Kootenay common points, namely, Nelson, Rossland, Sandon, Kaslo and Grand Forks, B. C., the Transcontinental Passenger Association has on sale daily Nine-Months Tourist fares, approximating two cents per mile in each direction, or about one fare and one-third for the round trip. The nine-months fares apply to the eastern gateways of the Transcontinental territory which are:—

Atchison, Kansas.	Memphis, Tennessee.
Chicago, Illinois.	Mineola, Texas.
Colorado Springs, Colorado.	Minneapolis, Minnesota.
Council Bluffs, Iowa.	New Orleans, Louisiana.
Denver, Colorado.	Omaha, Nebraska.
Fort Worth, Texas.	Pueblo, Colorado.
Houston, Texas.	St. Joseph, Missouri.
Kansas City, Missouri.	St. Louis, Missouri.
Leavenworth, Kansas.	St. Paul, Minnesota.

Station agents will cheerfully advise delegates as to the eastern points to which it will be most advantageous for them to purchase nine-months tickets in reducing through to Cleveland.

Proportionately higher fares are made to principal Atlantic seaboard points and to interior points such as New York, N. Y.; Baltimore, Md.; Philadelphia, Pa.; Washington, D. C.; Boston, Mass.; Montreal, Que.; Albany, N. Y.; Pittsburgh, Pa.; Buffalo, N. Y.; Detroit, Mich.; Toronto, Ont.; Cincinnati, Ohio.; Indianapolis, Ind.; Atlanta, Ga., etc

The nine-months fares do not apply to intermediate or interior points, but only to what are known as the eastern gateways of the Association, such as those named, including also Colorado Common Points. Should it happen that delegates apply at a station on the Pacific Coast from which the nine-months fare is not in effect, which may be the case at very small, unimportant stations, the agent will cheerfully ascertain and advise them the nearest point to his station from which such fare does apply.

Official Buttons

The official button of the Association will be supplied to all members whose dues are paid, including dues for the year 1913. These will be furnished at the meeting on application to the Secretary.

Exhibits

Several members have signified their intention to place on exhibition specimens of insects or breeding apparatus of various kinds. In addition to this the Ohio Agricultural Experiment Station will

make an extensive exhibit of injurious insects in their various stages. This exhibit is used at agricultural fairs and will be of wide educational and practical interest to members and visitors.

Program

Wednesday, January 1, 1:30 p. m.

Report of the Secretary.

Report of the executive committee, by President Hunter.

Report of the employment bureau for entomologists, by F. L. Washburn, St. Anthony, Park Minn.

Report of the committee on nomenclature, by Herbert Osborn, chairman, Columbus, Ohio.

Report of the committee on testing proprietary insecticides, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on affiliation with agricultural organizations, by F. M. Webster, chairman, Washington, D. C.

Report of the committee on legislation, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on affiliation of the Horticultural Inspectors with the American Association of Economic Entomologists, by T. B. Symons, chairman, College Park, Md.

Report of the committee on entomological investigations, by T. J. Headlee, chairman, New Brunswick, N. J.

Appointment of committees.

Miscellaneous business.

Action on proposed amendment to the constitution.

Strike out the first sentence in Article II, Section 1. In the following sentence after the word "entomologists" add "horticultural or apiary inspectors," so that the sentence will read as follows: "All economic entomologists, horticultural, or apiary inspectors employed by the federal or state governments . . . may become members." In Article III, Section 1, omit the last sentence, which provides for the appointment of the membership committee by the President of the Association.

New business.

Annual address of the President, W. D. Hunter, Dallas, Texas.

Reading of Papers

"Further Data on Heat as a Means of Controlling Mill Insects," by George A. Dean, Lawrence, Kans. (10 minutes.)

The temperature required, amount of radiation necessary, and results of heating several large mills.

"Notes on the Rice Water-Weevil, *Lissorhoptrus simplex* Say., and its Control," by Wilmon Newell, College Station, Texas. (15 minutes.)

An account of the writer's observations on this insect in the rice belt of Louisiana during 1909. Notes on feeding habits of adults and larvæ, host plants, longevity, probable number of generations annually, etc. The clue to successful control of the pest by proper manipulation of the irrigating water is pointed out. Use of arsenical poisons for destroying the adults before oviposition is suggested.

"Some Experiments with Roëntgen Rays upon the Cigarette Beetle, *Lasioderma serricorne*," by A. C. Morgan and G. A. Runner, Clarksville, Tenn. (15 minutes.)

"*Schizoneura ulmi* (*fodiens*) distinguished from *Schizoneura lanigera* (*americana*)," by Edith M. Patch, Orono, Maine. (5 minutes.)

Distinctive specific characters are presented for these two aphides both of which curl the leaves of elm; and evidence is cited to show that both species are present in America as well as in Europe.

Adjournment.

Program

Thursday, January 2, 10 a. m.

Discussion of the Presidential Address

READING OF PAPERS

"New Destructive Insects in New York," by P. J. Parrott, Geneva, N. Y. (12 minutes.)

Brief account of the importance and distribution of a number of species new to the State of New York.

"The Introduction, Methods of Control, and Spread of the Mediterranean Fruit Fly in the Hawaiian Islands, and the Danger of Introducing this Pest into the United States," by Henry H. Severin, Madison, Wis. Lantern. (30 minutes.)

How the Mediterranean Fruit Fly was Introduced into the Hawaiian Islands, the results of experiments in trapping the pest with crude petroleum products, vegetable and animal oils, "Spray and Spraying" and Clean culture; the distribution of the pest in the Hawaiian Islands within two years and the power of flight of two thousand marked male fruit flies; and the danger of introducing the pest into the U. S.

"Organization for Effective Work," by F. W. Rane, Boston, Mass. (10 minutes.)

"A City's attempt to Trap Brown-Tail Moths," by C. H. Hadley, Jr., Durham, N. H. (5 minutes.)

The varying captures at arc light traps. Proportion of males and females.

"Results of Experiments in Controlling the Gipsy Moth by removing its favorite food plants," by A. F. Burgess and D. M. Rogers, Boston, Mass. (15 minutes.)

"Preliminary Review of the Parasites of *Coccus hesperidum* in California," by P. H. Timberlake, Whittier, Cal. (15 minutes.)

A short account of the habits and interrelationship of the different parasites and of their effeciency.

"Some external parasites of domestic fowls," by G. W. Herrick, Ithaca, N. Y. (10 minutes.)

"Some Natural Enemies of Red Spiders," by H. J. Quayle, Berkeley, Cal. (15 minutes.)

An account of the biology and capacity for feeding of representatives of five different Insect Orders.

Adjournment.

Program

Thursday, January 2, 1.30 p. m.

READING OF PAPERS

"Economic Entomology at the Second International Congress of Entomology," by L. O. Howard, Washington, D. C. (10 minutes.)

"Mosquito Control Work in Connecticut in 1912," by W. E. Britton, New Haven, Conn. Lantern. (10 minutes.)

Brief resumé of educational work, campaigns for raising funds, area drained. Cost of draining and oiling to abolish breeding places.

"Notes on little known habits of the spotted fever tick," by R. A. Cooley, Bozeman, Mont. (12 minutes.)

Attitude assumed while waiting for a host; reaction to passing shadows; sensitiveness to animal breath; avoidance of sunlight.

"Additional Notes on the biology of the Rocky Mountain Spotted fever tick, (*Dermacentor venustus* Banks)," by F. C. Bishopp and W. V. King, Dallas, Texas. (10 minutes.)

Notes on the life history, seasonal history and habits which have been made mainly since the publication of Bulletin No. 85 of the Montana Experiment Station and Bulletin No. 105 of the Bureau of Entomology, are brought together.

"Pellagra and the Sand-fly II," by S. J. Hunter, Lawrence, Kans. (15 minutes.)

"The Transmission of Infantile Paralysis by *Stomoxys calcitrans*, a résumé of Observations by Brues & Sheppard and Experimental Work by Rosenau & Brues and Anderson & Frost," by C. T. Brues, Forest Hills, Mass. (20 minutes.)

"The Stable Fly, *Stomoxys calcitrans* L., its Bionomics and Life history," by C. Gordon Hewitt, Ottawa, Can. (20 minutes.)

"The Stable Fly, *Stomoxys calcitrans* L., an important Live Stock pest," by F. C. Bishopp, Dallas, Texas. (15 minutes.)

The severe outbreak of this pest in Texas during 1912 is discussed. The importance of the species in other parts of the United States is considered and notes on the life history, habits, natural enemies and methods of control are included.

"Notes on comparative tests with Zinc Arsenite and Arsenate of Lead," by W. J. Schoene, Geneva, N. Y. (5 minutes.)

Includes feeding tests with Insects and effect on foliage.

"Results of the Arsenical Poisoning Investigation," by E. D. Ball, E. G. Titus, and J. E. Greaves, Logan, Utah. (10 minutes.)

Summary of results, effect of arsenicals and alkalies on leaves, on bark, and study of affected regions with suggestions as to real cause of trouble ascribed to above.

"Arsenical Residues on Fruit," by W. C. O'Kane, Durham, N. H. (12 minutes.)

Determinations of the amount of poisons adhering to ripe fruit after spraying; summary of analyses.

"How Contact Insecticides Kill," by G. D. Shafer, East Lansing, Mich. (8 minutes.)

On the influence of Carbon Disulphide and Gasoline vapors upon the activity of Oxidase Extract of Insects.

"Injuries following the application of Petroleum and Petroleum products to Dormant Trees," by E. P. Felt, Albany, N. Y. (15 minutes.)

"The Success of a Two-spray Calendar in a Kansas Orchard," by H. B. Hungerford, Lawrence, Kans. (10 minutes.)

Adjournment.

Program

Friday, January 3, 10 a. m.

READING OF PAPERS

"The Codling Moth and One spraying in the Hudson Valley," by E. P. Felt, Albany, N. Y. (10 minutes.)

"Fall Spraying for the Pear Psylla," by H. E. Hodgkiss, Geneva, N. Y. (10 minutes.)

Results of Experiments to protect pear orchards by fall spraying.

"Peach Stop-back, the work of the Tarnished Plant bug," by Leonard Haseman, Columbia, Mo. (15 minutes.)

Recent outbreaks, life history, food plants and remedies.

"Notes on Three Common Tree Crickets," by P. J. Parrott and B. B. Fulton, Geneva, N. Y. (15 minutes.)

Oviposition, habits and host plants.

"The Sugar Cane Insects of Porto Rico," by D. L. Van Dine, Rio Piedras, P. R. (15 minutes.)

A list, with notes, of the insects affecting sugar cane in Porto Rico.

"The Arrangement of Material in an Entomological Bulletin," by R. L. Webster, Ames, Iowa. (10 minutes.)

This paper considers an arrangement of matter for an entomological bulletin which separates the popular and technical discussion; the first being placed at the front portion of the bulletin, followed by the second.

"Entomological Pioneering in Arizona," by A. W. Morrill, Phoenix, Ariz. (15 minutes.)

Entomological conditions, experiences, observations and prospects in a field new to economic entomology.

"Apparatus for Maintenance of Thermal Climatic Conditions," by S. J. Hunter, Lawrence, Kans. (10 minutes.)

"The Sugar Beet Leaf-Hopper," by E. D. Ball, Logan, Utah. (10 minutes.)

Distribution, amount of damage, method of attack and remedial measures.

"Some Notes on *Laphygma frugiperda* in Porto Rico," by Thomas H. Jones, Rio Piedras, P. R. (10 minutes.)

Notes on occurrence and life history of the species in Porto Rico.

"Recent Studies on the Weevil and Bud Moth of the Walnut and a Saw fly attacking Blackberry," by W. E. Britton, New Haven, Conn. Lantern. (10 minutes.)

Brief presentation of life history and injury of each of these pests, about which little or nothing has previously been known.

"Controlling the Apple Leaf-Hopper in Missouri," by Leonard Haseman, Columbia, Mo. (15 minutes.)

Notes on life history, work of the pest in Missouri and methods of controlling it.

"The Unspotted Tentiform Leaf-miner of the Apple," by Leonard Haseman, Columbia, Mo. (15 minutes.)

Life history, recent outbreaks in Missouri and methods of control.

Final Business Session

Report of committee on auditing.
Report of committee on resolutions.
Report of committee on membership.
Report of other committees.
Report of committee on nominations.
Election of officers.
Miscellaneous business.
Fixing the time and place of the next meeting.
Final adjournment.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.

W. D. Hunter, *President*,
Dallas, Texas.

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NOTES ON THE BIOLOGY OF CHELONUS TEXANUS CRESS[1]

By W. DWIGHT PIERCE and T. E. HOLLOWAY, *Bureau of Entomology, U. S. Department of Agriculture*

In this paper we describe the very peculiar life-history[2] of *Chelonus texanus* Cresson. In brief the adult Chelonus deposits its eggs in the eggs of its hosts but the parasite emerges not from the egg, but from the larva developed therefrom. Oviposition in the host's egg and retarded development of the parasite to permit the host to hatch and grow to considerable size has been pointed out by Marchal (Summarized by Bugnion, 1907. Smithsonian Report for 1906, pp. 310-314) with reference to the *Encyrtus fuscicollis* Dalman which ovipogits in the eggs of *Hyponomeuta malinella*, etc., and by Silvestri (Biologia del *Litomastix truncatellus* (Dalm.). Portici, pp. 4, 5, 10, 1906) with reference to *Litomastix truncatellus* Dalman which oviposits in the eggs of *Plusia gamma* Linnæus and other Lepidoptera. *Litomastix truncatellus* is polyembryonic and possibly pædogenetic in alternate generations; *Encyrtus fuscicollis* is also polyembryonic, but the Chelonus we have observed is a single and simple parasite. The Litomastix adult measures only 1.9 mm. in length and the egg of Plusia measures 0.6 mm. in diameter. Chelonus measures fully 5 mm. and the eggs of Heliothis measure about 0.5 mm. in diameter, while those of Laphygma are still smaller. Thus the contrast is much more striking when one observes Chelonus ovipositing than it would be in observing Litomastix.

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[1] Published by permission of the Chief of the Bureau of Entomology.

[2] It appears since sending in the above manuscript that during the summer of 1912 Mr. R. A. Vickery, of the Bureau of Entomology, at Brownsville, Texas, confirmed these observations in regard to Chelonus and Laphygma. It also appears that Mr. T. H. Parks, also of the Bureau of Entomology, reared Chelonus from Laphygma through two generations at Greenwood, Miss., confirming in all respects the observations reported by Mr. Pierce in the above article.

The earliest record in the files of the Southern Field Crop Laboratory indicating the habit of oviposition of Chelonus was made by Mr. J. D. Mitchell at Victoria, Texas, August 17, 1909, when he observed several adults of *Chelonus texanus* apparently ovipositing in the numerous egg masses of some undetermined Lepidopterous insect on the walls of a house.

At Brownsville, Texas, on March 11, 1911, the junior author made the following note:

"While collecting eggs of *Heliothis obsoleta* Fabr. on young corn this morning I noticed a Hymenopterous parasite on a leaf. I disturbed it slightly but it would not leave its place. I then noticed that it was standing over a dark Heliothis egg, with its ovipositor in the position for parasitizing the egg."

The parasite, which was found to be *Chelonus texanus* was caught and was taken to the laboratory, where it was placed in a tube with about two hundred Heliothis eggs. It oviposited in one egg after another, spending from five to thirty seconds at each egg. Heliothis larvæ emerged from the eggs on March 13 to 15. A number of these larvæ were reared and observed for parasitism. On April 6 one larva was dead and a white Chelonus larva had emerged from it. The dead Heliothis larva was about one fourth of an inch in length and the parasite larva was about the same length. The body of another Heliothis larva, which had probably died a day or two earlier, was dried into a small lump. The Chelonus larva which had emerged from this second Heliothis larva was very active. Both of these Chelonus larvæ died without pupating, but by April 13 two Chelonus cocoons were obtained from the lot of Heliothis larvæ from the parasitized eggs. On April 24 one adult of Chelonus emerged from one of these cocoons and was placed with another Chelonus, both from eggs of the original female. Both parasites seemed to be females, though one was larger than the other. They seemed to desire to escape from the glass tube in which they were confined, and they showed no desire to copulate. On April 25 fifty Heliothis eggs were placed in the tube, but oviposition was not observed. By May 12 the smaller parasite, which must have been a male, had died. The other parasite was given Heliothis eggs on a piece of corn leaf. It examined the corn leaf and then the eggs, and forthwith began to oviposit.

The parasite collected on March 11 was placed with about seven hundred Heliothis eggs in four lots of from one to two hundred eggs. During the period from March 11 to March 20 the parasite probably oviposited in most of these eggs. It was given drops of a solution of sugar and water for food, and sometimes it fed greedily. The parasite

had a habit of drawing up its legs and feigning death when disturbed, as does the boll weevil and many other insects. The ovipositor is blunt at the apex. It is pressed straight into the egg. An interior process undoubtedly pierces the shell of the egg.

At the time the notes mentioned were made, the junior author spoke of the matter to several entomological friends, but they were all so reluctant to believe that a Braconid which was approximately half as large as a house fly would oviposit in Heliothis eggs or in any eggs at all that nothing was published on the subject.

While searching for egg masses of *Laphygma frugiperda*, which were quite abundant at Dallas on many kinds of trees, the senior author on September 23, 1912, twice observed specimens of *Chelonus texanus* on egg masses, apparently ovipositing. They were very easily removed with the eggs to tubes without in the least disturbing them. The egg masses probably contained about one hundred and fifty eggs each and the parasities were at least as large in bulk as half the mass. They would feel with their antennæ over the surface of the eggs and then advance and insert the slender ovipositor in an egg, then in less than a minute would withdraw the ovipositor and insert it in the next egg. This process continued for a long time, with many surveys for unparasitized eggs.

The unusual abundance of egg masses which were beginning to hatch on September 23 was preceded a few days before by large flights of moths. Coincident with this abundance was the appearance of many adults of *Chelonus texanus* which were exploring grass and trees, and were often found at the nectaries of cotton, castor-bean and peach. It was therefore a simple matter to collect specimens for isolation with egg masses not too far advanced. This abundance of Chelonus was noticed at the same time in 1911.

On October 15, just twenty-two days after the large series of egg masses were collected, the first two Chelonus larvæ left their hosts, which were but slightly more than one-half inch long, and began to spin their beautiful, thin-meshed white cocoons.

Fifty-seven broods of Laphygma larvæ were under observation subsequent to September 23, and from twenty-five of these, Chelonus was bred. The first cocoon was formed October 18, and the others during a period of ten days thereafter. From these twenty-five broods, after they had reduced their own numbers by cannibalism, there were only forty surviving worms and fifty-five parasites. In fourteen broods the last surviving worms were parasitized. Records of the period prior to cocoon formation were made on twenty-six parasites with the range twenty-five to thirty-two days and with an average of twenty-six days.

On October 5, from an egg mass collected September 12 at Argenta, Ark., only three worms remained, they having gradually exterminated their mates although in the presence of plenty of food. All three of these worms were parasitized by *Chelonus texanus* and the parasite larvæ issued between October 5 and 8, leaving nothing but skin and head shield. The hosts were about one-half inch long when killed. Two of these parasites became adult between October 17 and 28, after a twelve to eighteen-day period in their cocoons.

The parasitism has a peculiar effect on the Laphygma larvæ. They grow and feed apparently quite normally and their cannibalistic habits are not in the least diminished by the presence of a larva within their bodies, perhaps they are more cannibalistic. When about one-half inch long, if parasitized, the worm makes a cell. This would probably be in the soil under normal conditions. This cell is supported by a fine meshed yellow silk cocoon. Within two days after completing the cell the larva dies, and on the next day the parasite larva emerges from a hole about the middle of the body. There remains nothing of the host larva but the shrivelled skin and the head shield. The parasite proceeds to spin its beautiful white cocoon within its host's yellow cocoon, taking one or two days for the process. The time of emergence of the parasite seems to depend almost entirely upon the size of the host. If it grows and feeds slowly, so does the parasite within.

The premature spinning of a cocoon by the host larva long before it could possibly be ready to pupate is a striking example of the results of parasitism. This habit also gives added security to the parasite when it emerges.

It is also of interest to compare the two host species thus far studied. Heliothis deposits single uncovered eggs and Laphygma deposits great masses of eggs in several layers (several hundred to a mass) and covers them with scale like hairs.

It appears that this habit of oviposition may not be characteristic of all species of Chelonus for Silvestri in describing the habits of *Chelonus elæaphilus* Silvestri and *C. orientalis* Silvestri indicates that oviposition probably occurs in the very young larval hosts (Silvestri. La Tignola dell'Olivo. Portici. 1907. pp. 154-157).

The determination of the Chelonus was made by Mr. Henry L. Viereck, to whom we owe our acknowledgments of his kindness.

THE LIFE HISTORY OF TETRASTICHUS ASPARAGI CRAWF.[1]

By H. M. RUSSELL and F. A. JOHNSTON, *Bureau of Entomology, United States Department of Agriculture*

Tetrastichus asparagi was first recorded in July, 1909, as an enemy of the common asparagus beetle (*Crioceris asparagi* Linn.), by Dr. H. T. Fernald,[2] who published another short article on the same insect in August of that year.[3] In these papers Doctor Fernald described the habits of the female in ovipositing in the egg of the host and stated that it appeared as if this insect would be an efficient egg parasite of the asparagus beetle. Unfortunately, through press of other matters, he could not devote sufficient time to this insect so that he did not rear the adult, and so failed to observe the strange life cycle, and the equally interesting feeding habits of the mature insect. This species was described by Mr. J. C. Crawford, of the United States National Museum, in October, 1909.[4]

While the writers were located at Riverhead, Long Island, N. Y., during the summer of 1912, this insect was observed in large numbers. The observations here recorded were made on its life history and habits at that time. The junior writer by his careful manipulation was successful in carrying this insect through its complete life cycle.

On June 10 the writers were inspecting a field of asparagus at Aquebogue, that was being cut for market. This field had a few uncut rows that had been left as a trap to attract the asparagus beetles and on these rows the asparagus beetle was very abundant and the eggs were found on the plants in large numbers. Associated with these beetles in noticeable numbers were the adults of this parasite, often from five to seven occurring on a single stalk. Observation revealed that these were ovipositing repeatedly in the eggs of the asparagus beetle and at the same time destroying many of the eggs by feeding on them. This feeding was so extensive that out of 2,097 eggs counted on 28 stalks of asparagus, 1,495 had been destroyed.

A number of adults of this parasite were brought into the laboratory and allowed to oviposit in the eggs of the asparagus beetle. Instead of the adult parasite emerging from these eggs, however, the larvæ of the beetle came out, but died from lack of tender food. This result

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[1] Published with the permission of the Chief of the Bureau of Entomology

[2] A parasite of the Asparagus Beetle, Cir. 23, Mass. Agr. Exp. Sta. (1909).

[3] A Parasite of the Asparagus Beetle, Journal of Economic Entomology, vol. 2, pp. 278-279 (1909).

[4] *Tetrastichus asparagi* n. sp. Proc. Ent. Soc. Wash., vol. 11, p. 150 (1909).

was very astonishing, as this insect had been looked upon as an egg parasite. However, it confirmed the opinion of the senior writer that, inasmuch as the adult was twice as large as the host egg, it could not develop to maturity in the egg. It seems that, unknown to the writers, Mr. W. F. Fiske of the Bureau of Entomology had held the same view, for he suggested to Doctor Chittenden last fall that, as the parasite was so much larger than the egg of the asparagus beetle, it could not possibly breed from it, but must come from a much larger beetle. He thought that a species of *Trirhabda* which feeds on *Solidago* sp. was most likely to be the true host of this insect and that its habit of feeding on eggs of the asparagus beetle was an acquired one. Mr. Fiske, however, also missed the connection in the curious life history of this insect, possibly because he had not observed it in the field.

As true oviposition had been noted in the eggs of the asparagus beetle, and as this parasite refused to feed on the eggs of the potato beetle (*Leptinotarsa 10-lineata*) and of the elm leaf-beetle (*Galerucella luteola*), even when confined with nothing else, the senior author held to the view that the asparagus beetle, in some stage, must be the true host. Dissection of the eggs of the host, by the junior author, revealed the eggs of the parasite and it appears as if this insect must develop in the larva of the beetle.

On June 10, when this insect was first observed, the senior author collected a number of nearly mature beetle larvæ and brought them into the laboratory These entered the ground on June 21 and formed pupal cells. These cells were dug up on July 2 and examined. Many contained the pupæ of the beetle, but one was found to be packed with six white parasitic larvæ and nothing remained of the host but the black larval skin. These larvæ were about mature and some days later changed to pupæ, but all died in that stage. Thus, for a second time this life-history problem failed of being solved, as it was not proven that the insect that parasitized the egg of the host belonged to the same species as the larvæ that developed in the host larvæ. The writers, nevertheless, felt encouraged to continue the investigation.

About July 10 another lot of asparagus-beetle larvæ was collected by the junior author and placed in large vials in the laboratory. When examined July 24, many had changed to adults of the asparagus beetle, but in one vial there were three pupæ of a parasite similar to those previously observed. On August 1 and 2 the adult parasites emerged and were identified by Mr. J. C. Crawford as *Tetrastichus asparagi*.

During the last half of July, after an absence of several weeks, the adult of this parasite was again discovered in the asparagus fields feeding and ovipositing in the eggs of the beetle. At that time the

plants were large and the eggs scattered widely throughout the fields, so that the parasite had also scattered and was very hard to find. A number of the parasites were collected, however, and taken into the laboratory by the junior author and confined in vials with eggs of the asparagus beetle. When the parasites had oviposited in them these eggs were removed and the sprigs of the plant bearing them were put in moist earth until the larvæ of the beetle hatched. These larvæ were carefully supplied with fresh food from time to time and when full grown were allowed to pupate in the bottom of the vials in soil provided for that purpose. Many formed their pupal cells along the sides of the vials and could be observed from time to time without being disturbed.

A few days after going into the soil the beetle larvæ began to change to pupæ and still later numbers of them were observed from which the parasitic larvæ had emerged.

The larva of *Tetrastichus asparagi* when mature is from 2 to 2.5 mm. long and 1 mm. wide; it is ovate and widest near the head, which is bent under the body. The color is white, with the alimentary canal appearing greenish. The surface is smooth and shining and devoid of hairs. There are no legs and the larva seems to be incapable of motion except to move the end of the abdomen around when disturbed. In a few days after destroying the host, the parasitic larva changes to the pupa.

The pupa of this insect is about 1.5 mm. long and 0.5 mm. wide and is yellowish white in color. It is convex dorsally with the head bent under and the inconspicuous wing pads are folded along the side, while the antennæ and legs are folded under ventrally. The head, thorax and abdomen are distinctly differentiated from each other, the abdomen tapering posteriorly. During the latter part of the pupal period, the pupa darkens considerably and just before emergence is nearly black, with the eyes bright red. From 7 to 11 days were spent in the pupal stage and as the adults emerged from the ground in from 24 to 36 days after the host eggs were parasitized, the egg and larval stages together required 17 to 25 days.

The living adult of this insect has the head and thorax bluish green, and the abdomen green with coppery iridescence. The antennæ are black and the eyes dark red while the wings are hyaline with black venation. The legs are black, except tips of femur, tibia and tarsi which are orange-yellow. The head is transverse and the abdomen well rounded and ovoid. This insect is variable in size ranging from about 1.5 to 2 mm. in length.

As soon as the adults emerged from the pupæ they began an

active search for the eggs of their host and within a few minutes after being placed with eggs began feeding and ovipositing in them.

The process of feeding is best described by the field notes as follows: The insect began a careful search over the asparagus, moving around very slowly with the antennæ held down in front of the head, but in constant vibration. In a short time the female discovered an egg and examined the surface all over with her antennæ. Then she climbed up on the egg until her head and thorax were above the top of it. The ovipositor was then exserted, from the underside of the abdomen, almost at right angles to the body. She then began an upward and downward movement of the abdomen and speedily forced the ovipositor into the egg. This was alternately thrust in to its full length and withdrawn for fully three minutes. During all of this time the antennæ were dropped in front of the head and held motionless. The female then withdrew her ovipositor and climbed down from the egg. She then placed her mouthparts to the tiny hole and sucked up all of the exuding egg contents. After this she climbed upon the egg again and after inserting the ovipositor drilled for eight minutes, after which she suddenly left the egg and went in search of another. When feeding began she always raised the antennæ to the horizontal, but kept them in constant vibration.

A number of adults that were observed in the field and in the laboratory were found to occupy from 1 1-2 minutes to 23 1-2 minutes in puncturing and feeding on a single host egg. Thirteen females that lived an average of 7.8 days, during their life time destroyed by feeding, 260 eggs of the asparagus beetle or an average of 20 each at the average rate of 2.5 per day. The largest number of eggs destroyed by a single female was 61 and the largest number destroyed in a single day was 12.

The process of oviposition was as follows: The female slowly crawled over the plants with the antennæ held forward and bent down, but in constant motion, carefully examining each object that she encountered. When she found an egg of the host, she carefully examined it with the antennæ and if satisfied climbed up on one side of the egg and lowered the abdomen a trifle. Then the ovipositor was exserted and thrust into the egg. There it was held for a short interval and then withdrawn—quite in contrast with the feeding habits, as the ovipositor was not worked up and down in the egg at all. Immediately the female left the egg and continued her search for more and when these were found she either continued oviposition, or began feeding again.

So far as this investigation has gone, reproduction has been observed by the asexual method entirely, as in two successive generations no males have been reared. Females confined in separate vials as soon

as they had emerged from the pupæ began oviposition in the host eggs and the adults were reared in these experiments.

In confinement this insect has continued oviposition from 1 to 17 days and lived from 5 to 21 1-2 days and during that time ovipositied in from 1 to 41 eggs of the host besides destroying from 1 to 61 by feeding. In the few eggs of the host that have been dissected from 1 to 5 eggs of the parasite were found.

The egg of the parasite is reniform with one end more slender than the other, about 0.24 mm. long and 0.0825 mm. wide, and is of semi-transparent milky color with a granular appearance within. While the eggs may be laid singly, in a number of cases they were found in pairs side by side.

In rearing this parasite from 1 to 9 adults have emerged from a single host larva, so that apparently for every egg of the parasite one adult results. Polyembryony, therefore, as in *Encyrtus*, *Litomastix*, and *Copidosoma*, so fully studied by Dr. Paul Marchal[5] and others and reviewed by Dr. L. O. Howard,[6] appear not to occur in *Tetrastichus asparagi*.

Apparently this insect has three generations a year in Long Island, for it was very abundant early in June at the time the first generation of the host was appearing, after which it disappeared, only to be found again in July with the second generation of the host. Since that time two generations have been reared under nearly normal conditions.

Undoubtedly this is a parasite of much promise, for not only does it check the asparagus beetle by its parasitic development, but it seems to do even more good from its habit of feeding so energetically on the eggs of this insect. The field where these observations were made has until this year always been sprayed to prevent serious injury by the asparagus beetle, but this year, although it received no treatment whatever, the asparagus beetles were so scarce that no damage resulted.

[5] Réchèrches sur la Biologie et le Developpement des Hyménoptères Parasites. La Polyembryonie Spécifique on Germinogonie. Arch. Zool. Exp. (4), vol. II, pp. 257–335, pls. IX–XIII (1904).

[6] Polyembryony and the Fixing of Sex. Science n.s., vol. 24, pp. 810–818 (1906).

NOTES ON LIXUS CONCAVUS

By HARRY B. WEISS, *New Brunswick, N. J.*

This beetle commonly known as the rhubarb curculio emerges from its winter quarters about the last week of May in the latitude of New Brunswick. It hibernates, presumably under débris commonly found in the field, inasmuch as two specimens were taken last December from under dead leaves and rubbish and one from under a loose piece of bark at the base of a stump. Careful searches at different times later in the winter resulted in none being found.

Egg deposition commences soon after emergence, as eggs were collected in the field on the first of June in the stems of *Rumex crispus*, which is undoubtedly the favorite food plant of the larvæ. Sunflower and thistle were examined for egg punctures with negative results and in one instance only, eggs were found in a species of polygonum or smartweed.

In dock the egg punctures occur from the base of the stem all the way to the tip of the plant and it is not uncommon to find from fifteen to twenty punctures in a stem three feet high. Occasionally they occur in the leaf petiole. Not all of these punctures, however, contain eggs, only a comparatively few. Upon cutting into some stems, many egg cavities were found to be empty and the surrounding tissue showed no evidence of larval activity. Other stems showed many empty egg cavities together with channels eaten by the first hatched larvæ. Sometimes these channels cut through egg cavities and other times cleared them. In either case more egg cavities were empty than should have been the case, especially as only one or two larvæ were usually found. From this one is forced to conclude that the beetles are either often disturbed during oviposition and get no further than the cutting of the cavity, or that the first larvæ which hatch out eat any eggs they may come across on their way to the root. No matter how many egg punctures are in a stem, not more than two or three larvæ can be found early in the season and later not more than one.

In the laboratory, eggs hatched in from seven to nine days during June and in the field egg laying continued up until July 20, after which no eggs were found. Egg deposition, however, is practically over by the middle of June as on June 19 one egg was found to eighteen larvæ.

The newly hatched larva first eats out a little chamber about a quarter of an inch or less above the egg cavity. This is really an enlargement of the egg cavity. It then goes down through the stem, cutting a more or less irregular channel, until the root is reached, where it

remains and does practically all of its feeding until full grown. There is one exception to this. Where the stem is thick and does not dry out rapidly, some larvæ eat a fairly large cavity in the base of the stem before attacking the root.

When the larvæ are young it is possible to find two or three in different portions of a single stem. Later, however, one to a single plant is the rule except where the root is large and supports several stems, then it is possible to find as many as three occupying different parts of the root. On seven different occasions I found larvæ feeding upon other larvæ and I feel that this explains the fact that only one larva is found in a plant containing numerous egg punctures. Inasmuch as they are carnivorous, they undoubtedly devour eggs also.

The first born larva evidently makes its way down the stem and feeds on any eggs into which its channel may cut. The second hatching from a place above the first or from an egg which escaped the first also makes its way down the stem and lives only until it reaches the cavity in the root made by the first, when it is devoured, assuming that the largest is always the victor. The second may also eat some eggs on the way down. I imagine that this procedure is kept up until only one remains. If the first larva goes some distance down in the root, larvæ hatching later may live longer if they cut a different channel, but in a small root supporting only one stem, the cavities are bound to run together and not more than one is found in a root of this kind. Undoubtedly some of the eggs which are laid late are crushed by the drying and contraction of the stem, as by July 3 the tops of many plants are dry and brown. From a large root supporting five stems, containing fifty-eight egg punctures, only three larvæ were found and these were in different cavities.

Of course some of these punctures may have been made for feeding purposes, but as the beetles also feed on the edges of the leaves, it seems somewhat unlikely that they would prefer the harder tissue of the stems.

From eight to nine weeks are required by the larvæ to reach maturity and in middle and south Jersey the majority are full grown by the second week in August. Owing to the period over which oviposition extends it is, of course, possible to find larvæ only one third grown at this date. As late as August 14, I have taken larvæ one third grown, full grown larvæ, pupæ and an immature beetle all on the same day. In the field the first pupæ were collected August 1 and the first adults on August 6.

From the second to the fourth week in August, the majority in the field were undergoing pupation and during the first week in September many adults emerged. By September 11 practically all had emerged.

The pupal period as determined in the laboratory, varied from ten to twelve days. Pupation takes place in cells of varying lengths, the tops of which are always on a level with the surface of the ground. When ready to emerge, the beetle cuts an oval opening about three-sixteenths of an inch in diameter in the now dry stem usually an inch or two above the ground. If the weather is warm it feeds somewhat on the young leaves around the base of the dock, but from the scarcity of beetles in the field after the first week in September, they evidently go into winter quarters soon after emerging.

If *Rumex crispus* is cut off several inches from the ground between the middle and end of July and rain occurs soon afterwards, a large percentage of the larvæ will die owing to the decay which sets in, practically all being in the roots at that time.

THE SUGAR-BEET WEB WORM

Loxostege sticticalis Linn

F. B. Paddock, *College Station, Texas*

The investigation represented in this paper was stimulated by an outbreak of the pest in the sugar-beet fields of Colorado in the summer of 1909. At that time the insect had inflicted severe damage before the growers were aware of it and were at a loss for control measures. A similar outbreak had occurred in 1903 but had evidently been of short duration. The writer endeavored to determine the life history and habits of the insect in that locality and to find, if possible, some control measures.

"For some reason writers on this species appear to have overlooked the fact that it is not native, but introduced from abroad, presumably on the Pacific coast, whence it spread eastward to Colorado and Nebraska. From specimens in the National Museum it seems that the insect was collected at Palmer, Utah, in July, 1869, which is evidence that it must have been introduced many years earlier. In 1873, it was taken in Central Missouri. It is also recorded from Winnipeg, Manitoba, as well as from several localities in Nebraska, Kansas and Michigan." [1]

The insect made its first appearance in Colorado in 1891 but did not become a pest until 1903.[2] In Nebraska the first outbreak of the

[1] Chittenden, F. H. Bureau of Entomology Bulletin, No. 33 pp. 46–49.

[2] Gillette, C. P. Colorado Experiment Station Bulletin No. 98.

pest occurred in 1893 [3] and in Michigan the first injury was noted in 1899.[4]

"Meyrick records this species as inhabiting England, Ireland, western and central Europe, and northern Asia as well as North America." [1] This species is known to European entomologists as *Eurycreon sticticalis* Linn. In central Europe the pest occurs periodically and in such numbers as to devastate the crops. The superstitious peasants consider these outbreaks a visitation of Providence, consequently control measures are rarely attempted and the pest spreads at will.

Food Plants. This species has been found feeding upon pig-weed (*Amarantus*), lamb's quarter (*Chenopodium*) beets, onions, cabbage and alfalfa in America. In Europe it has been found feeding upon a pig-weed (*Artemisia*), bindweed, wolfsbane, corn, the blossoms of plum, apple, cherry and peas and grasses.

Losses. As a result of the ravages of *L. sticticalis* growers estimate losses from 35 to 55 per cent in tonnage; analyses of the beets show a loss of 2 to 5 per cent in sugar percentage with a corresponding decrease in purity of the juice. In sections of Europe entire districts have many times been destroyed and the factories have remained closed. The farmers at such times left the beets in the ground, considering them profitable fertilizer for the soil.

Review of the Season of 1909. From notes made at Sterling, Colorado, by the writer, the following are quoted:

From June 18th to 30th the moths of the first brood were numerous on weeds and alfalfa around the beet fields. By July 15th the moths of the second brood were numerous in many beet fields. On July 23d a few eggs were observed and the moths seemed very active around the beets. A general outbreak of the worms throughout the entire district occurred on July 25th and by this time the moths were becoming scarce. The worms reached their maximum in numbers from June 26th to 31st. Considerable spraying was done during the first twelve days of August though the worms were rapidly disappearing. By August 23d the moths of the third brood were very numerous in the areas that were so badly eaten by the last brood of worms. The moths began at once to spread to the dense foliage of the beets surrounding the injured area. A few eggs were found on August 25th. By August 29th the moths were getting scarce and the few left were unable to fly, only fluttering along between the rows of beets. Parasites were taken on August

[3] Bruner, Lawrence. Bureau of Entomology Bulletin No. 30. (O. S.) p. 37.
[4] Pettit, R. H. Michigan Experiment Station Bulletin No. 180 p. 254.

30th which proved to be *Agathis (Cremnops) vulgaris*. The moths had entirely disappeared from the fields by the first of September.

Lantern traps were tested against the second brood of moths but were put out too late to be of value as the moths fly only at night during the first few days after emergence.

Paris green was used by many farmers, applied by means of a dust sprayer, at the rate of one pound per acre. This did not seem effective against the worms and it severely burned the foliage of the beets. Some used the liquid spray, two pounds of Paris green and one pound of lime to fifty gallons of water. This did not prove effective and the burning was slight.

White arsenic, one part to four of flour, was used by some. This was very unsatisfactory as it burned the foliage badly and was not effective.

A tobacco decoction, one pound of stems to one gallon of water was tried. This solution was quite effective burning through the skin of the worms and there was no ill effect on the foliage.

A 10 per cent solution of kerosene emulsion was used but was not successful.

Review of the Season of 1910. An outbreak of the pest was expected during the season of 1910 and a careful inspection was maintained. It was possible to verify the life history and secure further information on the habits of the insect.

From notes made at Sterling, Colo., by the writer the following are extracted.

On May 13th a few moths were noticed on weeds in waste places some distance from the beet fields. A cold, windy spell occurred and much retarded the activity of the moths so that fertilization was not generally accomplished until May 30th. The first eggs were observed on June 8th and the male moths were becoming scarce. By June 17th the worms were quite abundant and the moths had practically disappeared. Parasites were taken often from June 21st to 29th. On July 11th moths of the second brood were taken and on the 13th they seemed very abundant, though in defined areas. The first eggs were observed on the 16th and the moths were spreading over the entire fields. The maximum number of worms occurred about July 22nd. Parasites were very abundant during this brood and the decreased number of worms evidenced their work. A few moths of the third brood were seen on August 1st. There were practically no larvæ of this brood as the parasites had killed most of the moths.

During the season of 1911 there were very few moths and those were mostly in weeds in neglected places. There was no injury to the beets

that year by the web worms and it will no doubt be several seasons before they occur as a pest again.

The Moth. The moth is from 10 to 11 mm. long and spans 21 to 22 mm. The upper wings are dark or grayish brown and carry four bands of brown. The under wings are much lighter and uniform in color. Most species of moths are on the wing only after dark or in twilight but this species is active at night only in its early life, never after egg deposition has started. During the day the moths are very active in the dense foliage, usually depositing their eggs on the under surfaces of the leaves. When disturbed they make a short irregular flight, usually alighting on a leaf, sometimes on the ground. They are very watchful and active.

Moths have been captured and found full of eggs, others taken at the same time contained none. This would indicate a range in the time of emerging or the time in reaching sexual maturity. This accounts for the worms hatching at different times. The male moths live but a short time; they do not apparently emerge earlier than the females. The females live a few days after the eggs are deposited. It has been estimated that one moth deposits from 500 to 700 eggs, these mature gradually during the period of oviposition. As a rule the moths appear in a field seven to ten days before the worms appear.

The Egg. The eggs are usually deposited singly, though occasionally in rows of three or five overlapping. The egg is pearly white in color, oval in form and about one mm. long and seven-tenths in diameter. They may be found on either side of the leaf, more often on the under side. After once seeing the eggs they are readily observed with the unaided eye. "At the end of the second day a black speck appears near one end of the egg which is the head of the young worm developing within the egg. In three more days the little worm eats a ragged exit hole in the shell and escapes." (Gillette.)

The Larva. The young larvæ are pale green, with a black head. They are so small when first hatched, measuring only four mm., that they are easily overlooked. Very soon the larvæ construct a small dense web, which serves as a protection while they are young. This is used only for the first two or three days and if disturbed while out feeding they will quickly draw under this web and curl up. During the first two or three days the larvæ eat but little and skeletonize the leaves instead of devouring them.

The mature larvæ are from 15 to 21 mm. long averaging 18 mm., with the head small and pointed. The body color is green with a preponderance of longitudinal markings. A light strip on the dorsal side carries an entire black line; the lateral stripes carry rudiments of black lines. The second and third generations are much darker than

the first, at times almost olive in color instead of green. The larvæ live for two weeks but do not eat during the last three or four days. During this period they are very restless and active, especially between ten o'clock a. m. and three o'clock p. m., until they have found a suitable place to pupate. The cocoon is twice the length of the larva and three times the length of the pupa.

The injury is done so quickly, sometimes within 36 hours, that the owner of the field is led to believe that the worms migrated from the adjoining fields during the night. No general migrations of the larvæ have been observed.

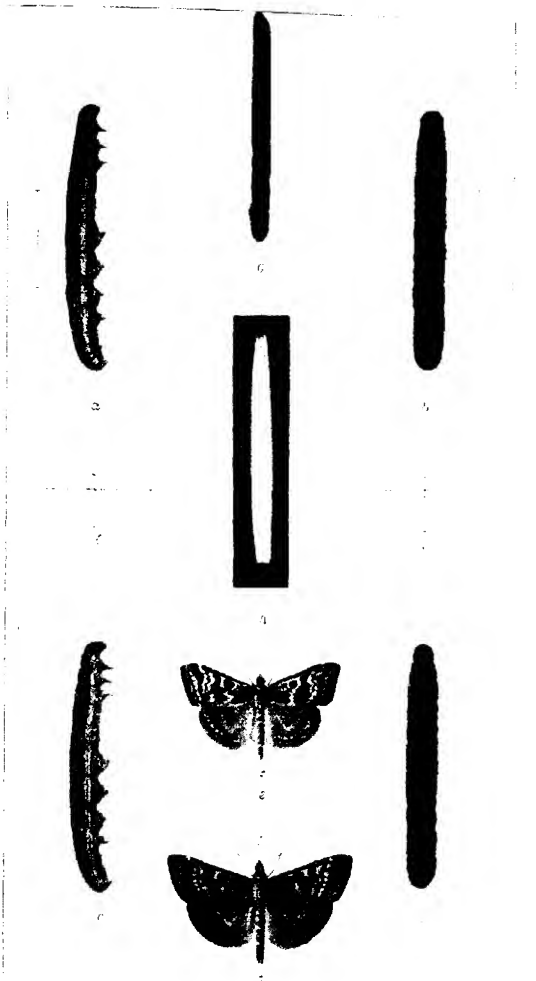
A peculiarity of the attacks by this insect is that in nearly every instance the heavy injury is well into the field, rarely ever along the edge. A small area of infestation will apparently spread each day, due to the fact that the moths in depositing their eggs work outward from their place of emergence. Cases have been noted where the worms in the center of the field had burrowed into the ground, while on the outer edges of the field they were still active. The injuries appear to be worse on fields that were exceedingly weedy the previous season. No difference in the infestation of beets on light soil and on heavy soil has been noted. Frequently a field may be badly infested and the adjoining one will be unharmed. On individual plants the young tender leaves were always last to be eaten. Only in extreme infestation are the beets eaten, and almost never is the entire leaf-crown destroyed. Beets that have been badly eaten usually send forth three or four small crowns of leaves.

The Pupa. Unfortunately it is hard to obtain uninjured pupæ. They are about 12 mm. long and of a bright bronze color. Pupation takes place in the ground in a silken cocoon, usually one-half to three-fourths of an inch below the surface. It is very tough and is covered with a layer of soil. The cocoon is three times the length of the pupa in the summer broods and four times in the over-wintering brood.

Life History. The hibernating larvæ pupate in May and soon emerge as moths. These give rise to the June brood of larvæ, seldom observed and not very abundant. These appear on weeds such as goosefoot (*Chenopodium*) and pigweed (*Amarantus*). Sometimes alfalfa serves as food for this first brood of larvæ.

The second brood of larvæ is at its height the later half of July. This brood is very short lived, requiring only two weeks for maturity of the larvæ and the appearance of the moths. The larvæ of this brood pupate almost immediately upon entering the ground. This is often the destructive brood of the season as it feeds entirely upon beets.

The third brood of larvæ reaches its maximum the latter half of



The Sugar-Beet Web Worm. *Loxostege sticticalis*. L. [illegible] the first generation; *c* and *d*, larvæ of the second [illegible] moth; *f*, female moth; *g*, cocoon with the adherent soil; [illegible] without the soil. (From "Über die im Jahre 1901 beobachteten Krankheiten der Zuckerrübe.")

August. This one may prove the most destructive of the season, often repeating the destruction by the July brood. The larvæ of the August brood enter the ground for hibernation. A few larvæ, however, pupate and emerge as moths during the latter half of September. There may be, then, three full broods and a partial fourth of this pest in a season.

Remedies. In general one could recommend, as a means of destroying the moths, the catching of them at night with lantern traps though this must be done in the early life of the moth. The lighting of a stubble field at night, adjoining the beet field, will attract the moths and they will fly into the flames. We learn many interesting methods employed in Europe where this pest is destructive. Few preventive means have been employed in America and most are unsatisfactory as the moths are not active after deposition of eggs has commenced.

Many interesting and effective devices are used in Europe to destroy the worms, but these have not proven practical under our conditions. It is very important to keep the fields free from weeds. If the worms are noticed in a limited area, a small stream of running water will confine them. If the worms have completed their destruction, the beets should be stimulated to growth as quickly as possible by good cultivation. In irrigated sections, the beets should be irrigated at once and then cultivated as soon afterwards as possible.

Fall plowing will, no doubt, do more than any other farm operation to prevent an outbreak of the web worms. If a beet field has become infested the ground should be well stirred in the late fall; this will break up many cocoons and expose the larvæ to the birds and the effects of freezing, also many cocoons will be buried so deeply that the moths can not emerge. Crop rotation is a great aid in the control of this pest and too much can not be said for clean farming methods.

Poisoning the Worms. The worms accomplish their work of destruction so rapidly that it is very important that the beet grower should be prepared to check the injuries as soon as they appear. As has been said, the worms live a few days after they have finished eating and for this reason much disappointment is experienced because the poison is applied too late to be of any benefit. "The safe way to control the pest is to poison the worms when young; they are hard to kill and poison must be applied in liberal doses." (Johnson.)

The Poison to Use. From experiments conducted it would seem that the best poison to use is arsenate of lead, applied either as a dust or liquid spray. This is effective against the worms and does not burn the foliage. If a dry spray is desired, two pounds of powdered arsenate of lead per acre may be safely used. If a liquid spray is used, two

pounds of lead arsenate paste to fifty gallons of water is an efficient and safe spray.

If Paris green is used one pound per acre applied dry or two pounds to fifty gallons of water with one pound of lime added, is all that can be safely applied.

Natural Enemies. Insect-eating birds devour the worms in large quantities and are the best friends of the farmer. When the worms are abundant blackbirds will be attracted in flocks of hundreds; cases have been reported where they completely destroyed the worms. The most useful birds are the blackbird, meadow lark, English sparrow and quail, in Europe the English sparrow heads the list.

This pest is unusually subject to parasitism by several species of Hymenoptera and Diptera. One of the most common is the parasitic fly *Agathis* (*Cremnops*) *vulgaris*. This parasite has often been reported as the means of preventing the August brood of moths from becoming destructive. By means of a long ovipositor it inserts an egg in the body of its host, which may be the larva or pupa. The limited number of this parasite is due to a secondary parasite *Mesochorus agilis* Cress.

Much valuable assistance has been given the writer by Prof. C. P. Gillette and Prof. S. Arthur Johnson of the Colorado Experiment Station, Mr. W. L. Lawson of Sterling, Colorado, and Mr. Oscar Rabbethge of Germany.

September 10, 1912.

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WILL THE MEDITERRANEAN FRUIT FLY (CERATITIS CAPITATA WIED.) BREED IN BANANAS UNDER ARTIFICIAL AND FIELD CONDITIONS?[1]

HENRY H. P. SEVERIN, PH.D., *Honorary Fellow, University of Wisconsin,* AND WILLIAM J. HARTUNG, B.S.

On June 24th, 1911, California placed a quarantine against all Hawaiian fruits excepting pineapples and bananas. A few months later extensive experiments were started at the College of Hawaii by the writers in order to determine whether the Mediterranean fruit fly could develop in green, ripe and over-ripe pineapples and bananas. While this work was in progress, the following letter was received from the president of the College of Hawaii:

November 9, 1911

Prof. H. H. Severin,
College of Hawaii,
Honolulu, T. H.

Dear Sir.—

I was yesterday informed by Judge Henry E. Cooper, President of the Board of Regents, that considerable anxiety exists regarding the possibilities of the Mediterranean fruit fly attacking bananas, and that this anxiety finds one of its phases in the investigations which you are conducting on the problem as to whether the fruit fly may naturally or artificially be propagated on this fruit. So great is this anxiety that a number of requests have been lodged with the President of the Board to have this work stopped and the *publication* or *announcement* of any data on this question thus far withheld. The President of the Board feels that if an affirmative report on this question should get out great damage would result to the banana industry and the College would be brought under severe criticism.

It is my personal opinion that the question is of great scientific importance whether negative or positive results are secured. However, it is my duty to convey to you

[1] Most of the results of this investigation were read by Mr. William J. Hartung before the Forty-first State California Fruit Growers' Convention at Santa Barbara, Cal., on June 13, 1912. See Mon. Bul. Cal. Hort. Comm. No. 9, Vol. 1, 566–69.

the wishes of the President of the Board that the investigations on this subject be stopped and the *publication* or *announcements* of results already obtained be withheld.

Very respectfully,

(Signed) JOHN W. GILMORE,
President.

Over a hundred breeding jars containing bananas and several dozens containing pineapples were emptied into a garbage can following this order from the Board of Regents. A request was made to the president of the College of Hawaii for sufficient time to await the results of these experiments, but this was not granted.

Mr. E. M. Ehrhorn, superintendent of entomology in the Hawaiian Islands, who was most bitter in his criticism against the work as it was conducted, argued that impossible conditions were created, from which false conclusions would be drawn and that nature would be tempted, for if the fruit flies were forced to breed in bananas, some of the specimens of the new generation might escape from the breeding jar and these would probably breed in bananas again. These arguments are not worth further consideration.

Realizing that millions of dollars were at stake in the United States if the fruit fly was able to breed in bananas and pineapples under natural conditions, for almost every week a steamer is carrying either bananas or pineapples into California from the Hawaiian Islands, we considered it our duty as entomologists to continue this investigation. As soon as this work was stopped at the College of Hawaii, a private room not in connection with this institution, was equipped with the necessary apparatus to conduct the interrupted research.

The first problem which we attempted to solve was: *Will the acids of the peel or the pulp of green Chinese bananas prevent the eggs of the Mediterranean fruit fly from hatching, and if not, what effect will these acids have upon the developing maggots?*

Female fruit flies, captured in the field while they were ovipositing in oranges, were taken to the laboratory and vivisected in order to obtain eggs; most of the eggs were dissected from the ovaries, others from the two oviducts and a few from the oviductus communis. Some of these eggs were inserted into the peel and pulp of green Chinese bananas and others within the peel and pulp of California oranges. If the eggs were to develop in the California oranges and not in the green Chinese bananas, we would have some fairly good experimental evidence that the fruit fly eggs cannot develop in green Chinese bananas. The eggs did not develop in either the oranges or the bananas. In all probability the eggs dissected from the ovaries and two oviducts were not fertilized, and since it was open to question whether

the eggs from the oviductus communis were fertilized, another method of attacking the problem was started.

Hundreds of Mediterranean fruit flies were captured in the field while they were laying their eggs in oranges, and these were placed in captivity in jars and fed on dilute molasses daubed on the sides of the jars. A few days later the females, now overloaded with eggs, were observed ovipositing on the sides of the jar. These eggs were introduced into different parts of green Chinese bananas, some of them being inserted within the peel, others within the pulp. Again as a check, California oranges were used. None of the eggs developed in either the bananas or oranges. The fact that the eggs did not develop in the oranges and bananas may have been due, it was thought, to the absence of the secretion which the female flies pour over the eggs or to a bacterial or fungus growth which always appeared, sooner or later, in the region of the fruit where the eggs were planted.

To obtain eggs over which the secretion had been poured by the female fruit flies, tropical almonds (umbrella tree or "kamani" nuts), which are seriously infested by this pest, were gathered from the trees. The tropical almonds contain weak acids, one of which is probably malic, while the green Chinese bananas contain stronger acids, one of which is tannic. The eggs of the fruit fly were now transferred from the tropical almonds into various parts of green Chinese bananas, some of the eggs being placed within the peel, others directly beneath the peel and still others within the pulp. In some cases the flower scar of the banana was cut out cone-shaped, the eggs were inserted into the pulp, and then the flower scar was placed back into its normal position again. All parts of the banana that had been cut, were sealed with soft paraffine to keep out bacteria and fungus spores. From 352 eggs which were placed in different parts of the bananas, only 2 female flies succeeded in completing their entire life cycle; both of these specimens developed from the eggs which had been placed within the pulp of the green Chinese bananas. Through the vitelline membrane of one of these eggs, the young maggot, especially the jaws at the anterior pole, could be plainly seen, whereas little or no development was apparent in the other egg when it was first introduced.

In the next experiment 73 eggs were transferred into various parts of Chinese bananas not as green as those used in the previous experiment. From these bananas 13 male and 18 female fruit flies emerged. Of the total number of eggs introduced into the peel and pulp of these bananas, 42 per cent gave rise to maggots which were able to complete their life cycle.

An experiment similar to the preceding was now performed with green Brazilian bananas. A total of 215 eggs were planted in these

bananas, 3 to 15 eggs being inserted in each fruit. Forty-eight male and 55 female flies succeeded to complete their life history in this case, i. e., over 47 per cent of the total number of eggs introduced into the bananas gave rise to fruit flies.

In our previous experiment with the green Chinese bananas it was found that from 352 eggs inserted into these fruits only 2 fruit flies succeeded in completing their entire life history. In order to determine whether the eggs actually hatch and the young maggots die in the acid medium of green Chinese bananas, 100 eggs were placed within the peel of 10 green Chinese bananas. A small piece of the peel was sliced off, the eggs were inserted into the wound and then the thin portion of the peel was placed back in its normal position and covered with soft paraffine. The vitelline membrane of the eggs turned black almost immediately after the eggs were introduced; this was probably the result of the chemical action of the tannic acid. Four days later the paraffine was removed, the small slice of the peel was raised and it was found that 69 eggs had hatched. Not one of these maggots, however, succeeded in completing its life history.

Half-grown maggots were now placed within the pulp of green Chinese bananas by first removing the flower scar as described in one of the previous experiments. The majority of these maggots died.

A similar experiment was performed with 20 nearly full grown maggots, one maggot being placed in each green Chinese banana. The results were as follows:

10 maggots bored out of the bananas and pupated.
2 maggots bored out of the bananas and died.
8 maggots pupated inside of the bananas.

The fact that 8 maggots pupated inside of the bananas instead of boring out indicated that the acid medium of the banana was unfavorable for the development of the larvæ. The maggots which bored out of the bananas and pupated in the jars were placed in moist sand and later issued as apparently normal flies.

The second problem which we attempted to solve was: *Will the Mediterranean fruit fly in captivity lay its eggs in green, ripe or over-ripe Chinese bananas?*

Again, hundreds of the adults were captured in the field while they were laying their eggs in oranges and these flies were then confined in jars containing from 6 to 12 green Chinese bananas. Occasional observations showed that the specimens did not deposit their eggs within the bananas, but only on the sides of the jars and the external surface of the bananas. The eggs deposited upon the peel, however, did not develop.

In the next experiment green Chinese bananas were immersed in orange juice from 12 to 48 hours with the hope that the odor of this juice would induce the insect to oviposit in the fruit. Again, as in the preceding experiment, specimens of Ceratitis that had been captured in the field were confined for several days in jars, each of which contained 2 bananas. After the lapse of this time, these bananas were transferred to jars containing about 2 inches of sterilized sand. No adults were bred from these bananas.

Fruit flies were next confined from 1 to 3 days in dozens of jars each of which contained 2 ripe bananas with the peel intact. As in the preceding experiment, the bananas at the end of this time were transferred to jars containing about 2 inches of sterilized sand. From all of these bananas there were but two from which adults were bred and these together gave rise to 19 male and 13 female flies.

Fruit flies were confined with ripe bananas from 4 to 5 days. These bananas, when transferred, showed evidence of blackened or decayed areas on the peel. The results from this experiment were as follows: 22 males, 18 females bred from 4 bananas that had been kept with the fruit flies for 4 days; 24 males, 14 females bred from 4 bananas that had been kept with the fruit flies for 5 days.

The third problem which we attempted to solve was: *Will the Mediterranean fruit fly in confinement deposit its eggs in the exposed pulp of green or ripe Chinese bananas?*

Fruit flies that had been captured in the field were confined for several days in jars, each of which contained 2 green Chinese bananas with a portion of the peel removed. In this experiment a crust soon formed over the exposed pulp and later became covered with a fungus growth. From time to time both the crust and the fungus were scraped off with a knife. With one exception, no fruit flies were bred from the green bananas treated in this manner. In the exception, the pulp of the banana had split longitudinally, the peel had been removed so as to expose this crack and also a considerable amount of pulp immediately surrounding the split region. Decay set in along the split region and from this banana fruit flies were bred.

An experiment similar to the preceding was then performed with ripe bananas. The exposed pulp served not only as a favorable food material for the adults, but also a suitable medium for the growth of the maggots. The late Mr. F. W. Terry of the Hawaiian Sugar Planters' Experiment Station was the first to obtain and report this result, and this was later confirmed by Mr. D. T. Fullaway of the Hawaii Agricultural Experiment Station.

Forcing the Mediterranean fruit flies to breed in green or ripe Chinese

bananas under artificial conditions would not prove that they will breed in bananas under field conditions.

During the mosquito campaign, when the banana trees were cut down in Honolulu, hundreds of bunches of bananas were examined to see if there was any evidence that that pest was breeding in bananas under field conditions. Hundreds of bananas containing maggots were removed from these bunches and placed in jars containing sterelized sand. From these bananas a small number of Mediterranean fruit flies, numerous specimens of an Anthomyid, *Acritochæta pulvinata* Grims.; 2 species of Ortalidæ, *Euxesta annonæ* Fabr. and *Notogramma stigma* Fabr. and a number of species of Drosophilidæ were bred. The fruit flies were bred from but 2 bananas, one of which when taken from the bunch was decayed at the flower scar and had a bruise extending through the peel. This banana when removed from the bunch was yellow in color beneath the decayed area and gradually shaded over to green towards the other end. The Anthomyid and two species of Ortalids mentioned above were also bred frequently from green Chinese bananas removed from bunches on growing trees in banana plantations. These bananas were decayed around the flower scar as shown in the following photograph:

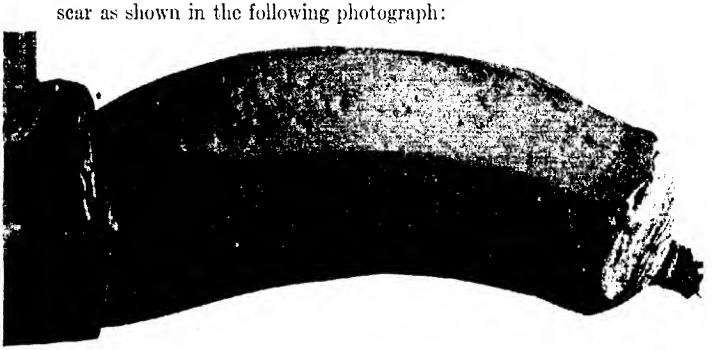

Fig. 10. Chinese banana with decayed area around the flower scar. From such green bananas the Anthomyid, *Acritochæta pulcinata* Grims. and the Ortalids *Euxesta annonæ* Fabr. and *Notogramma stigma* Fabr. were bred and from a similar banana but riper, the Trypetid, *Ceratitis capitata* Wied. was reared.

The following experiment shows that the Mediterranean fruit fly may possibly attack bananas in the field when not enough of their preferred fruits are available. During the latter part of April it was observed in an orchard that green and ripe lemons were covered with a resinous material which had oozed from wounds produced by the ovipositor of female flies. In this orchard there was little or no other

citrus fruit present at this time of the year. The fact that the females were actually observed stinging the lemons, suggested the idea that the flies might deposit their eggs in bananas when this fruit was suspended among the branches of the lemon trees. Hundreds of green Chinese bananas, in bunches from 2 to 6, were hung in lemon trees for 8 days. From only two of all of these bananas did we succeed in breeding fruit flies and from these, 8 males and 5 females were obtained; these bananas, when taken down from the lemon trees, were yellow with black or decayed areas in the peel. Dozens of ripe bananas with the peel intact were suspended for two days among the branches of lemon trees, and from all of these bananas there were but two from which we were able to rear the adult fruit flies. From these two fruits 3 males and 1 female were obtained. From an over-ripe banana with the peel entirely black and which had remained in the lemon trees for two days, 1 male was bred.

In a discussion over the results of this paper before Dr. A. J. Cook, E. K. Carnes, F. Maskew, E. O. Essig, and H. A. Weinland, officers of the California State Commission of Horticulture, Mr. Weinland who is connected with the fruit fly work in the Hawaiian Islands gave his results of an experiment which he performed with the Mediterranean fruit fly and these results he has kindly permitted me to publish. In his experiment, bananas were suspended in an orange tree which had been stripped of its fruit; the tree was then covered with cheese cloth and the fruit flies were allowed to emerge from infested fruit within this tent. He claims that the pest was bred from ripe bananas with the peel intact and also from ripe bananas with a portion of the peel removed.

Although the fruit fly has been bred under field conditions from ripe and over-ripe bananas with the peel intact, Mr. F. Muir of the Hawaiian Sugar Planters' Experiment Station in a discussion on this subject raised a point worth mentioning. This point was that the tannic acid in bananas decreases in strength when the fruit is removed from the bunches on growing trees and for this reason the field conditions were not strictly natural conditions.

Mr. George Compere has kindly called my attention to a bulletin written by Kirk[1] of New Zealand in which it is stated that the Mediterranean fruit fly was actually bred from bananas and pineapples intercepted at the wharf.

This paper had been sent to Prof. E. P. Felt, editor of the Journal of Economic Entomology, when we came across, in the library of the University of Wisconsin, a reprint from the *Journal of Agriculture*

[1] Kirk, F. W. 1909. Fruit Flies. Bull. 22, Dep't of Agric. New Zealand, p. 9.

of Victoria, May 8, 1907, by C. French, Government Entomologist, Department of Agriculture, Victoria, on Fruit Flies, Bulletin No. 21, Department of Agriculture and Intelligence of South Australia. Since French claims that he has proved eggs to have been deposited in green bananas by the Mediterranean fruit flies on many occasions, we requested the editor to return our manuscript so that we could quote this author in full.

In the first paragraph of his paper he says that the Mediterranean fruit fly "larvæ have been found in peaches, pears, quinces, apricots, plums, nectarines, guavas, oranges, lemons, apples, citrons, loquats, mangoes, pumpkins, *bananas*, tomatoes, *pineapples*, etc.

"The larvæ of this fly were found in bananas imported from Queensland on the 14th August, and on being placed in the breeding jars pupated on the 20th August; the perfect flies emerged on the 4th October and lived for several weeks, etc.

"It has frequently been stated in Queensland and New South Wales that the flies will not attack green fruit. This is a mistake, as I have on many occasions proved eggs to have been deposited in green bananas before shipment, as no half-ripe bananas are ever shipped from Queensland to Melbourne."

Speaking of the origin of the pest in new localities French writes, "From observations made in the field, I am speaking of the northeast part of Victoria, the trouble has been traced through the medium of imported fruits, bananas and oranges especially, infested fruits of both kinds being commonly obtainable in Melbourne, the suburbs, and in the country townships.

"As one who has seen the fly at work both in New South Wales and Queensland, I assert that the ravages of the Mediterranean fly in Victoria are quite as bad as either the Queensland or New South Wales experiences have been able to record, half-green peaches being attacked as badly as those either ripening or ripe. . . . It has been questioned by some persons whether this fly is found in Queensland at all, but the fact of it having been reared by us from bananas and oranges from Maryborough places the matter beyond the shadow of a doubt. If such be not the case, then the fruit must have been affected during transit, a theory which I for one, will not entertain."

I wish to call attention to the fact that French is well aware of the fact that the Queensland fruit fly (*Dacus tryoni* Froggatt) is a serious pest of the banana, for he writes, "The maggots are always found in over-ripe or decaying fruit or in cracked bananas, and these are the ones that should be discarded as soon as the bunches are looked over."

Summary

We are hardly justified in drawing conclusions as to whether or not the fruit fly will breed in green Chinese bananas under natural conditions from the results of the investigation carried on under artificial conditions.

From 452 eggs which were placed in different parts of green Chinese bananas, only two fruit flies succeeded in completing their entire life history. One hundred of these eggs were planted within the peel of green Chinese bananas and 4 days later 69 eggs had hatched; but all of these maggots died, probably from the effect of the tannic acid. From Chinese bananas which were not quite so green as those used in previous experiments, 42 per cent of the eggs that had been inserted within these gave rise to adult flies. The majority of the maggots that were inserted when they were about half grown within the pulp of green Chinese bananas died in the acid medium. Nearly full grown maggots, when placed within green Chinese bananas, usually completed their larval development but often pupated within the fruit.

Mediterranean fruit flies were bred both under artificial and field conditions from ripe and over-ripe bananas with the peel intact and from ripe bananas with the pulp exposed. Under laboratory conditions, the peel of a green Chinese banana was removed around a longitudinal split extending within the pulp; decay set in along this crack and from this banana fruit flies were also bred. Under field conditions green Chinese bananas were hung among the branches of lemon trees; and from these bananas, when they became ripe and overripe, adults were reared. Fruit flies also emerged under field conditions from 2 bananas which were removed from the bunches of banana trees that had been cut down during the mosquito campaign in Honolulu. One of these bananas was decayed at the flower scar and a bruise extended through the peel beneath this region; this banana was yellow in color below the decayed area and gradually shaded over to green towards the attached end.

We wish to express our sincere thanks to Mr. Frederick Knab of the Bureau of Entomology, Washington, D. C., for the identification of *Notogramma stigma* Fabr. and to Mr. J. R. Malloch of the same Bureau for the identification of *Acritochaeta pulvinata* Grimm.

THE POISON EXPONENT: A SYMBOL OF THE TOXICITY OF CHEMICALS IN THEIR RELATION TO INSECTS[1]

By T. E. Holloway. *Bureau of Entomology, U. S. Department of Agriculture, Audubon Park, New Orleans, La.*

During the season of 1910 the writer, under the direction of Mr. W. D. Hunter, conducted a series of experiments with certain poisons on larvæ of the cotton boll worm, *Heliothis obsoleta*. While preparing a report of these experiments the writer felt the need of some method of expressing the toxic value of chemicals to insects, and he finally concluded that this value might be obtained by comparing the number of days of life of the poisoned insect and of the unpoisoned insect. To illustrate: if the poisoned insect lived one day while the unpoisoned or check insect lived three days, both being subject to the same environmental conditions except that of the poison, the relationship between the life of the poisoned insect and the life of the unpoisoned insect might be expressed by the following proportion: life of poisoned insect is to life of unpoisoned insect as 1 is to 3. Or,

$$\frac{\text{Life of poisoned insect}}{\text{Life of unpoisoned insect}} = \frac{1}{3} = .33+,$$

which number may be taken as the indicator of the toxic value of the poison. Lack of data prevented the publication of this theory.

On account of other work the writer was unable to continue the poison investigations until this year, when preparations were made to determine the toxic values of a number of poisons to Heliothis. An outline[2] was made which was similar to that used in 1910, but under field conditions it was changed in the matter of food and cages for the larvæ. The experiments were then started, but before they had progressed very far an important obstacle was noticed. The poisoned larvæ died within a day or two, but the unpoisoned larvæ lived for a much longer period, in the natural course of their life cycle. It was obvious that the environmental conditions to which the unpoisoned larvæ were subject after the death of the poisoned larvæ were of not the slightest value in the determination of correct toxic values. In

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[1] Published by permisssion of the Chief of the Bureau of Entomology.

[2] This outline was thoroughly discussed with Mr. W. D. Hunter and Mr. W. Dwight Pierce, of the Bureau of Entomology. Mr. Pierce suggested experimenting with each instar of Heliothis, and gave the writer a list of poisons to be tested. The writer takes this opportunity of thanking Messrs. Hunter and Pierce for their kindness in coöperating.

order to obtain indicators which were even approximately correct it would have been necessary to conduct all experiments in a place where temperature and humidity were unvarying or varying always in the same degree. The pupation of the unpoisoned larvæ complicated the matter further. In outlining the experiments the time of pupation of a larva was arbitrarily taken as the end of an experiment, but this procedure is of course open to objection.

The experiments were discontinued and a new outline[1] of work was prepared. This outline took Paris Green as the standard poison, and larvæ subjected to it were taken as checks. Paris Green, besides being universally known, kills the larvæ very quickly, so that the entire life of a check larva is of use in determining the toxic value of a poison. The original outline had called for experiments with many different dosages of the different poisons, but because of other work it was necessary to adopt a uniform dosage of two milligrams per leaf, which is equivalent to a rather thorough field poisoning.

The idea of the toxic value of a poison was also changed. The present conception may best be explained by algebraic symbols.

Let x = an unknown poison.

Let Paris Green = 1, or standard in toxic value.

Let us suppose that an insect subjected to x dies after 10 hours, and that an insect subjected to Paris Green dies after 5 hours.

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[1] The outline as finally adopted is in part as follows:

Paris Green Lavanburg will be taken as the standard, and the larvæ subjected to this poison will be known as checks.

The Poison Exponent for any poison will be obtained by comparing the length of life of the larvæ subjected to that poison with the length of life of a larva subjected to Paris Green Lavanburg at the same time. Duplicate experiments will be conducted if sufficient larvæ are available.

The poisons will in every case be evenly applied to the leaves in the form of a dust. Two milligrams per leaf will be applied.

Experiments will be conducted with tin boxes as cages, a two-ounce size for the larger larvæ and a one-ounce size for the smaller larvæ.

One larva to a box.

Larvæ will be given young cowpea leaves of as nearly a uniform size as possible.

After forty-eight hours' exposure to poison in each case, unpoisoned food will be provided until death.

Notes to be made at bi-hourly intervals of feeding in each cage.

Records to be kept on cards, devoting one card to a larva.

For duplicate experiments, cards will be numbered with letters following the regular numbers as 1a, 2a, etc., for the first set of duplicates, 1b, 2b, etc., for the second set, and so on.

The experiments will fall into two series:

Series I. Tests with all instars.

Series II. Tests with the most resistant instar as determined by the tests in Series I.

It will be noticed that the toxic values of the two poisons vary inversely as the lengths of life of the insects subjected to them, if the length of life of the poisoned insects be taken to indicate the toxic values of the chemicals. Then, toxic value of x is to toxic value of Paris Green as 5 is to 10.

The product of the means of a proportion being equal to the product of the extremes, we have,

10 (toxic value of x) = 5 (toxic value of Paris Green).
Then, toxic value of x = 5-10 (toxic value of Paris Green).
But toxic value of Paris Green = 1.
Then toxic value of x = 5-10 × 1 = .50, which may be called the Poison Exponent of x.

In the case of a quicker poison than Paris Green let us suppose again that the insect subjected to Paris Green dies after five hours, while the insect subjected to x dies after 4 hours.

Again the toxic values of the two poisons vary inversely with the lengths of life of the insects subjected to them.

Then toxic value of x is to toxic value of Paris Green as 5 is to 4.

4 (toxic value of x) = 5 (toxic value of Paris Green),
Toxic value of x = 5-4 (toxic value of Paris Green),
Toxic value of Paris Green = 1,
Toxic value of x = 5-4 × 1 = 1.25 = Poison Exponent of x.

It seems that we have here reached a law which may be stated as follows: *If the length of life of a poisoned insect may be taken to indicate the toxic value of the chemical to which that insect is subjected, then the toxic values of two chemicals vary inversely with the lengths of life of two insects respectively subjected to them, assuming that the insects are of the same species and at the same period of their life cycle, and that environmental conditions are equal.*

The experiments with all instars of *Heliothis* will give some examples of the actual determination of Poison Exponents. The poison used was Arsenate of Iron Grasselli. A first instar larva subjected to this poison died within 8 hours, while one subjected to Paris Green under the same environmental conditions and at the same time died within 4 hours. To obtain the Poison Exponent of Arsenate of Iron Grasselli for the first instar of *Heliothis*, we divide 4 by 8, which gives .50. The other instars were treated in a similar manner. At this point a word of comment may not be out of place. The Poison Exponent of .50 for Arsenate of Iron Grasselli for the first instar of *Heliothis* merely indicates that a larva subjected to that poison lives twice as long as a larva subjected to Paris Green, other environmental condi-

tions being equal. But to say that Arsenate of Iron Grasselli is therefore worth only half the market price of Paris Green is to make a statement that may or may not be true. Factors other than the Poison Exponent are to be considered in determining the market value of a poison.

Second instar: The larva subjected to Arsenate of Iron died within 6 hours, while the larva subjected to Paris Green died within 2 hours. Poison Exponent = 2-6 = .333+.

Third instar: The larva subjected to Arsenate of Iron died within 27 hours, while the larva subjected to Paris Green died within 22 hours. Poison Exponent = .81+.

Fourth, fifth and sixth instars: The larva subjected to Arsenate of Iron died within 46 hours, while the larva subjected to Paris Green died within 22 hours. The Poison Exponent for each of these instars is .47+. Attention is called to the fact that observations were made bi-hourly through the day from eight or nine in the morning till five or six in the evening. When larvæ died during the night the deaths were not recorded until the next morning. The larvæ of all the instars but the first and second died during the night, with one exception, so that the Poison Exponents for the larger instars are most probably not correct. In future work it will be necessary to make observations at bi-hourly intervals continuously until the deaths of the larvæ. In order to obtain correct Poison Exponents it will also undoubtedly be necessary to make many duplicate experiments and take the average of the results obtained for any one exponent. This probable necessity arises from the fact that conditions for work are seldom ideal and that mistakes and incorrect interpretations will be made. The average of a large number of results will tend to obviate the discrepancies of a few of them.

Larvæ of *Heliothis* were not found after these preliminary experiments were made, and as other work was more pressing the greater number of the outlined experiments were not conducted. If they had been carried out as planned, however, the necessity for continuous observations would have rendered many if not all of the results valueless, as the services of no one were available for the night observations.

As to the economic benefit to be derived from the application of the Poison Exponent, we can only try to imagine what might occur if it came into use. Many new chemicals have been put on the market within the last few years, and the properties of the greater number of them are probably unfamiliar to most entomologists. The Poison Exponents of these chemicals for a number of species could be ascertained in a comparatively few months, while years would be consumed if the new poisons were to become known in the slow process of unre-

lated experiments by scattered workers. This is one of the uses of the Poison Exponent, but it is likely that others would develop. For instance, the statement of a reputable manufacturer that his new preparation has a Poison Exponent of .75 to the most resistant instar of the boll worm would doubtless convey in the course of time a more definite idea to the mind of the entomologist than would a chemical analysis, valuable though the latter might be.

Whether the Poison Exponent is ever used or not, however, the writer cannot but believe that the subject of toxic values of chemicals to insects is a matter that is worthy of some consideration, and he hopes that other workers will give it the attention it deserves.

NOTES ON INSECT DESTRUCTION OF FIRE-KILLED TIMBER IN THE BLACK HILLS OF SOUTH DAKOTA

By PHILIP L. BUTTRICK, *New Haven, Conn.*

This paper attempts to outline the results of the work of insects following forest fires in the Black Hills of South Dakota; and to suggest remedies for their depredations. It is the result of casual observations of the writer, made while Forest Assistant on the Black Hills National Forest in 1911, and later as Forester for the Lanphere-Hinrich Company, a lumber company operating in the Black Hills. The observations do not pretend to approach completeness; but may be of some value in the absence of more definite data.

Character of the Forest in the Black Hills. Western Yellow Pine (*Pinus ponderosa*) is the predominant tree. It occurs pure over large areas, being the only commercial tree found. The forest tends to be even-aged in groups, but many stands are all-aged or roughly two-storied. The Government manages its holdings by a rough application of the shelter-wood system, the intention being to come back in twenty to thirty years for the second cut.

Enemies of the Yellow Pine. Forests in the Hills have suffered excessively from insects and fire. The chief insect enemy, the Black Hills Beetle[1] is too well known to require description. Its depredations have now been controlled by natural agencies, and by cutting large bodies of infested timber. A close watch is now kept by the

[1] *Dendroctonus ponderosæ* Hopk.

Forest Officers for all signs of beetle infestation, and all infested trees are at once cut and the bark destroyed.

A leaf scale, probably *Chionaspis pinifoliæ*, occurs, chiefly on seedlings and saplings. Its attacks are sometimes fatal. However, so long as it is not more abundant it need not be regarded as dangerous; perhaps it is slightly beneficial, since it usually occurs in dense overstocked thickets of young growth, where a thinning is badly needed.

The dry climate and the character of the forest operate to render fires numerous and severe, especially so in young growth where they often burn into the crowns. In old stands, particularly if there is no reproduction on the ground, they are confined to the surface and do less harm. Fires burning through irregular stands where the flames mount into the tops of the smaller trees, kill most of the stand but destroy little timber.

Destruction of Fire-Killed Timber. As a result of fires many thousands of feet of otherwise merchantable timber are killed annually. Much of this is never used. A knowledge of the rate of its subsequent destruction and methods of preventing it would result in saving much of it, thus reducing the drain on the live timber of the region.

Both insects and fungi attack trees killed by fire, their attacks being to some degree interrelated.

Fungi. Von Schrenk has given an account of two important fungi attacking beetle-killed trees, and they are also found on trees killed by fire. One, the "blue" fungus (*Ceratostomella pilifera* Winter), speedily stains the sapwood; the other, the Red-Rot (*Polyporus pondcrosa* von Schrenk), follows after a longer interval, and causes the wood to decay. Other fungi attack live trees, but are not important here.

Insects. The chief insects infesting dead timber are, in the Black Hills, ambrosia beetles and the larvæ of Cerambycid and Buprestid beetles.

Hopkins lists two ambrosia beetles, *Gnathotricus sulcatus* LeConte, and *G. occidentalis* Hopkins, as occurring on beetle infested pine in the Black Hills. It is probable that these are the forms which occur on fire-injured and killed trees. Their attacks seem more apt to be directed towards injured than dead trees.

Ambrosia beetles bore in sapwood and to a less extent in heartwood. They cultivate a fungus in their burrows which stains the adjacent wood. These burrows also serve as a means for the extension of the "blue" fungus. The seasonal history for the species in the Black Hills has not been worked out in detail. The adults, however, seem to fly throughout the growing season, and to hibernate in their burrows

during the winter, several generations are doubtlessly produced in a season.

More important than the ambrosia beetles are the deep-wood borers,—the Cerambycid and Buprestid beetles,—whose larvæ make large burrows deep into the wood.

The destructive "Sawyer" (*Monohammus titillator*) of the Southern States seems not to be present in the Black Hills. The chief damage is done by the larva of a Buprestid beetle, probably the Heartwood Pine Borer (*Chalcophora virginiensis*) or one of its western forms *oregonensis*, or *angulicollis montana*. The three forms mentioned do not differ materially. All are large metallic lustered, bronze colored beetles, about an inch long and a quarter of an inch wide. They fly with a distinct buzzing sound.

The larvæ are elongated, whitish, flatheaded, legless grubs. The head is yellowish to brownish, and armed with strong jaws, which can be heard as it excavates in its burrow. The length at maturity is an inch and a half or more.

The adults fly in July, during the third week of that month the woods are full of them, but by the end of the first week in August all seem to have disappeared. The flying season probably lasts from the middle of June to the last of August at the outside.

The eggs are layed in holes cut in the bark by the female, occasionally in living, more often on recently dead trees. They hatch in a few days, and for a few weeks bore in the bark. Under favorable circumstances they may enter the wood within a month; by the end of two months, if conditions are favorable, they may have bored into it for two inches. The larval stage lasts till the following season, and may last for two years. Their activity does not continue after cold weather sets in, and the wood freezes.

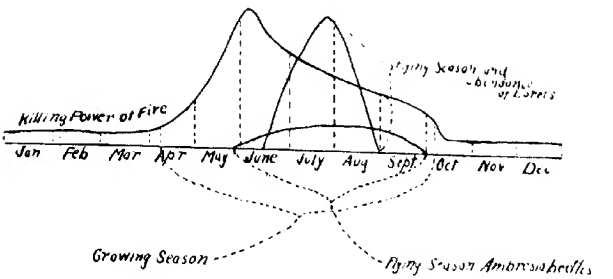
Character of Insect Damage. Ambrosia beetles aid in bluing fire-killed timber, but it is seldom that the sapwood escapes bluing even without their assistance. If timber is cut before it is badly infested by the larger borers, the work of the ambrosia beetles is usually removed with the slabs.

The larger borers if abundant will in time completely riddle a log, so that it is worthless save as firewood. In a single season they may reduce its value from thirty to fifty percent.

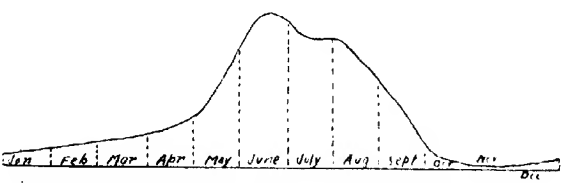
Effect of the Season of the Fire. The severity of attack by boring insects varies with the season of the fire. It can of course take place immediately after one only during the season when the adults are flying. The further removed from this period the fire comes the less will be the strength of the beetle attack, since the wood has more chance to dry out and the bark to become detached.

Plate 14

CURVE I.

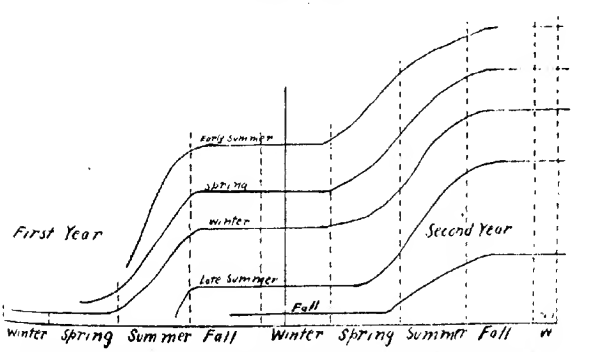


CURVE II



Degree of infestation following fires at different seasons

CURVE III



Probable rate of destruction by borers of timber killed at different seasons

The optimum conditions for attack seem to be following fires occurring early in the growing season. At such times the killing power of fire is at its highest. The moist condition of the wood causes fermentation and a rise of temperature. This favors the rapid growth of the larvæ, giving them time to become well established before seasoning of the wood and cold weather interferes.

On a large area burned about the middle of June, infestation by the last of August was so severe that the ground under the trees was white with the dust from the borings, which could be seen drifting to the ground like a light snow. The gnawing of the larvæ sounded like the croaking of innumerable frogs. An area close by burned in March was much less severely infested.

Rate of Destruction. Foresters and lumbermen in the Black Hills recognize the fact that fire-killed timber is generally worthless after it has stood two years. The relation of the season of the fire to the rate of destruction is not so well understood.

Timber killed just before the flying season will be practically worthless in fifteen months, or by the following fall, while timber killed after the growing season may not be as badly riddled after two years and a half. A close study of the rate of destruction would be of great value.

An attempt is made to express some of the facts regarding infestation and destruction graphically. The curves shown are for the most part relative as we do not possess sufficient data to make them entirely specific. The table derived partly from Curve III., would, if accurately worked up, be of value, by showing the time necessary to effect the injury and destruction of timber killed at different seasons.

Influence of Site on Severity of Attack. Wood borers prefer moist wood, and are therefore most frequent in localities where the wood is damp, such as in canyons, on steep north slopes etc., where there is protection from the sun and winds. On the tops of ridges exposed to wind and sun timber seasons quickly, and infestation is therefore often slight. The writer has examined timber from such localities that was unaffected by borers although it had been dead for several seasons. The proximity of a burned to an infested area is favorable for the spread of the pests.

These facts should be kept in mind in projecting a cutting in a recently burned area to prevent infestation. Timber in damp situations and that near infested areas should be removed or barked first.

Natural Checks. The large amount of dead timber scattered through the Black Hills as a result of the beetle invasion and the numerous fires have given a splendid and not neglected opportunity for wood borers.

It is probable that the pure character of the forest acts in their favor, the same as it does with other insect pests.

Woodpeckers eat many beetle larvæ, and are apt to congregate in burned areas where they are numerous. The Hairy Woodpecker is quite common and is the chief bird enemy of the Buprestid larvæ. Early in September the writer observed many at work in an area burned in June. They seemed to confine their attentions largely to the smaller trees, mostly the saplings fifteen to twenty-five feet high. They dug an inch or more into the wood for the grubs. Other woodpeckers occur in the Hills, but were not observed eating larvæ on recently killed trees. Probably Chickadees and Nuthatches eat the eggs and small grubs before they enter the wood, but are not able to dig into it after them.

Birds seem to serve more in keeping down the numbers of the pests than in saving timber already infested, since after borers are two or three inches into the wood only the larger woodpeckers can reach them, and then only when the wood is partly decayed.

Remedies. The obvious remedy for the destruction of fire-killed timber is of course to prevent fires. This attempt is made on the National Forests and the more valuable private holdings; but, like fires in cities, some forest fires will always occur despite all precautions.

The next best thing is to harvest the burned timber at once. This is often impossible, since it takes time to effect a timber sale on a National Forest, even when a purchaser is at hand. When roads and camps must be built it may require several months to prepare for cutting. If a fire occurs between June first and August fifteenth, it is almost impossible to get at the timber before infestation commences, much less remove any large bodies of it. However, if it can be cut and sawed within six weeks little damage would be done since the borers would still be near the surface, and would be removed with the slabs.

If timber is killed after the middle of August, there is a longer time for safe removal, although it will be attacked by ambrosia beetles and the bluing fungus till the coming of heavy frosts.

Lumbermen frequently want to know how to prevent the destruction of dead material without at once removing it. It is often proposed to cut and bark it, removing it to the mill at a more convenient season. This if carefully done is effective, but more costly than might be supposed. Barking costs about fifty cents per M feet B. M., which is half as much as felling itself costs. There would be no profit in barking small top logs, since it does not pay to handle these except under the best of conditions. It is doubtful if any large amount of timber could be kept from bluing by this method.

If logs are badly infested and the larvæ are well into the wood, it is doubtful if merely barking them would destroy the pests. In such cases it would be better to build skidways in the open above the surface and pile the logs onto them in such a way that the air could get at them from all sides, so as to facilitate seasoning. Care should be taken not to deck them up in tiers, as this interferes with seasoning. Such a method would be more expensive than letting the logs lie on the ground; but would tend to prevent bluing, and would probably kill all borers.

Another remedy often proposed is to cut dead or infested material and immerse it. This not only prevents all infestation, but kills all larvæ already in the wood, and prevents fungus attacks. It is not suitable in the Black Hills, since no natural ponds exist, and the cost of building dams large enough for the storage of large quantities of logs is prohibitive. The running of infested material through a log pond to kill the borers has been suggested. This works if the logs are in the water long enough. The writer has noticed that good sized logs after remaining in the pond at the Lanphere-Hinrich mill for two or three days had live borers at their centers when sawed. Logs would have to remain in the pond until they were thoroughly soaked out, perhaps a week or more, rendering the process slow, and perhaps not possible for any large amount of timber.

If a systematic attempt were made to apply this method, it might be well to experiment with poisonous solutions in the water, such as copper sulphate or mercuric chloride. These might shorten the time necessary for immersion, and would tend to prevent reinfestation, or fungus attacks.

Uses for Infested Material. A lumberman frequently finds himself in possession of an amount of infested timber, which he does not wish to lose. What can he do with it?

It may of course be manufactured into common lumber and sold for what it will bring as "number two common." Or perhaps it may be disposed of as firewood. The demand for both of these is small, and no large amount of either can be marketed at one time, moreover the profit is small. For it costs as much to handle burned as green timber, and the price on the finished product is from a third to a half lower, in addition to a greater waste in manufacture.

Railroad ties are sometimes sawed from fire-killed timber, but are not very satisfactory. However, if they could be treated with a timber preservative, they would be more valuable in many cases than green ties. While the larger railroads in the Black Hills have treating plants, they draw their timber supplies mostly from elsewhere.

The establishment of a commmercial treating plant in the Black Hills would solve many of their problems of wood utilization.

The use of untreated infested material for mine timbers is not usually advisable, since the moist conditions prevailing in most mines allow the continued existence of both insects and fungi, which speedily destroy the timbers, necessitating frequent renewals.

A certain lumberman in the Black Hills has solved for himself the problem of the use of fire-killed and infested timber, by turning it into box boards. There is a large and steady demand throughout the Middle West for them by the large meat packing companies. He has no difficulty in disposing of any fire-killed material, no matter how much blued or infested, so long as it is not affected with red-rot.

This solution of the difficulty is not at the disposal of the small man with a portable mill, for it requires a special outfit to saw the match box boards. He might in some cases sell his burned material to a box mill after sawing it out in the rough.

Summary. Destruction of fire-killed timber is largely accomplished by Buprestid beetles, whose larvæ riddle it. In from fifteen months to two years and a half they, in combination with fungi, entirely destroy it for commercial purposes.

The rate of damage varies with the locality of the timber and the season of the fire, being at its maximum in moist localities, following fires in the early part of the growing season.

Remedies. Prevent fires, cut and remove fire-killed timber at once, if this is not possible, bark burned and infested trees and place them on skidways to season. Ponding is the best remedy, but is not generally possible. Running of infested logs through a log pond would destroy borers if the logs were left in long enough. The use of poisonous solutions in the water should be tried.

Infested material can be used in small amounts for low grade products, and for box boards; but often it will not pay to handle it.

TABLE I.

PRELIMINARY TABLE SHOWING RATE OF DESTRUCTION OF FIRE KILLED TIMBER.

Season of Fire	Infested	Partially destroyed	Entirely destroyed
Spring	In a few months	That fall	Following fall
Early Summer	Immediately	That fall	Following fall
Late Summer	Partially at once	Following fall	Two years
	fully following season		
Fall	Following Summer	Following fall	Two [illegible]
Winter	Following Summer	Following fall	Two [illegible]

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NOTES OF THE SEASON FROM CONNECTICUT

By W. E. BRITTON, *Agricultural Experiment Station, New Haven, Conn.*

During the year some interesting and rather important investigations have been conducted by this department. In Connecticut the walnut weevil, *Conotrachelus juglandis* Lec., has been so destructive that for several years it has been nearly impossible to obtain fruit of the various imported and cultivated walnuts belonging to the genus *Juglans*.

In nearly all of the scanty literature this weevil is said to breed in the nuts, but in Connecticut, the larvæ do much greater damage by tunneling in the new shoots, causing them to wither and die before they can produce fruit. My assistant, Mr. H. B. Kirk, has worked out the life history of *C. juglandis* the past summer. Very little has heretofore been known regarding it. A bud moth, *Acrobasis* sp., also attacks and injures the new growth and Mr. Kirk has studied this insect, finding three generations each season.

Though these studies represent only one season's work, the results indicate that both the weevil and the bud moth can be controlled by spraying the foliage and shoots with lead arsenate. A complete account of the work mentioned above, including bibliography, and distribution of the walnut weevil in the United States will appear during the winter in the next report of the Station (12th Report of the State Entomologist of Connecticut).

For three years Mr. B. H. Walden has been making observations upon a sawfly found defoliating cultivated blackberries in a field near New Haven. A knowledge of its life history is now complete and the insect being a new species of the genus *Pamphilius* was described by Prof. A. D. MacGillivray in *Canadian Entomologist*, Vol. XLIV, October

1912, page 297, as *P. dentatus*. The work of this insect, which will be described in the report mentioned above, resembles that of the peach sawfly, *P. persicum* MacG., studied five years ago by Mr. Walden, and which is still doing sufficient damage in some Connecticut orchards, to warrant the spraying with lead arsenate of several thousand trees in 1912.

Studies are also in progress upon the white pine weevil, *Pissodes strobi* Peck., and other insects attacking the pine trees in Connecticut.

The cold wet spring seemed favorable for the increase of aphids of nearly all kinds. The rosy apple aphis, *A. sorbi* Kalt., was more abundant and caused more injury than since 1909, and the green apple aphis, *A. pomi* DeG. was also common.

White grubs, *Lachnosterna*, did more damage than I have seen in the state during a residence of eighteen years. Not only were grass fields injured, but the roots of corn and strawberries were eaten, and in some cases the potato crop was nearly destroyed by them. In one forest nursery nearly 25 per cent. of the seedling pines, spruce and deciduous trees were eaten off under ground.

The fall army worm, *Laphygma frugiperda* S. & A., was received from Stonington, Groton and from two different localities in New Haven in September. In three places it was devastating lawns, and in the other case it was feeding upon a field of millet.

The flight of the cotton moth, *Alabama argillacea* Hubn., was much less noticeable than in 1911, and occurred more than two weeks later in the season. Around New Haven the moths were not nearly so abundant as last year, but were most numerous on October 11 and 12. In 1911 the date of their greatest abundance was September 26.

Good progress has been made in the control of the gypsy moth, *Porthetria dispar* Linn. At Stonington no caterpillars have been found since 1910, and it is regarded as wholly exterminated there. At Wallingford, 26 caterpillars were found last summer where 1,551 were taken in 1911 and 8,936 in 1910. Both localities will be watched for some time and in a few weeks, both state and federal scouts will examine them for egg masses.

The brown-tail moth, *Euproctis chrysorrhœa* Linn., has spread southward slightly since last year, involving portions of the towns of Brooklyn, Plainfield and Sterling. An isolated colony was discovered during the summer at Norwich several miles southward and a single winter nest was found at Stafford Springs several miles west of the previously infested area near the northern border of the state.

The birch leaf skeletonizer, *Bucculatrix canadensisella* Chamb., though much less abundant in the eastern portion of the state than in 1910, was found over the entire state as in 1911, and was particularly

noticeable on the yellow birches in Litchfield County in September. It was also received at this office on cut-leaf and other ornamental birches from various localities.

In addition to the insects mentioned, the usual pests such as the San José scale, *Aspidiotus perniciosus* Comst., the tulip tree scale, *Toumeyella liriodendri* Gmel., the pine bark aphis, *Chermes pinicorticis* Fitch., the spruce gall louse, *Chermes abietis* Linn., the woolly maple leaf scale, *Phenacoccus acericola* King., various aphids, the spiny elm caterpillar, *Euvanessa antiopa* Linn., the elm leaf beetle, *Galerucella luteola* Müll., the red humped caterpillar, *Schizura concinna* S. & A., the white marked tussock moth, *Hemerocampa leucostigma* S. & A., the fall canker worm, *Alsophila pometaria* Harr., the bumble flower beetle, *Euphoria inda* Linn., the rose chafer, *Macrodactylus subspinosus* Fabr., and the various species of cutworms have all been in evidence.

Increased interest in the control of the house fly and mosquito nuisance has been manifested in various parts of the state, by the demand for illustrated lectures and for information regarding these insects. Mosquito control work has been taken up in a number of shore towns and nearly 3,000 acres of salt marsh have been drained the past season.

NOTES FROM KENTUCKY

By H. Garman, *Lexington, Ky.*

The San José scale has shown a disposition to extend its distribution in Kentucky with very great rapidity during the past two years. Our recent examinations of the Kentucky nurseries have shown that a larger proportion became infested during 1912 than in any previous year of my experience as state entomologist. Just what this rapid spread is due to would be difficult to explain. I have sometimes suspected that nurseries of other states were sending in infested stuff that was not properly fumigated and perhaps not inspected. A rapid growth of interest in fruit growing has accompanied this increase in the prevalence of the scale. Perhaps the two are associated.

Several other insects have attracted special attention during the past season. One is the chinch-bug, ordinarily not a troublesome insect pest in Kentucky and only appearing locally and occasionally in numbers sufficient to call for treatment. We have had a number of demands for the white fungus with which to destroy chinch-bugs doing mischief in some of our counties along the Ohio River this year.

A second insect worthy of notice is the fall army worm (*Laphygma frugiperda*), which began to attract attention in Kentucky in midsummer because of its injuries to millet and alfalfa. It continued until fall, doing most of its mischief to plantings of alfalfa and rye. The insect is believed to be a migrant and during the summer to come to us from the South. The adult, however, is constantly present in Kentucky during hot weather, though this is the first time in all my experience, covering more than a dozen years, when the injuries have attracted the attention of farmers.

The third insect deserving special mention is the southern cotton worm (*Alabama argillacea*). It is to be remembered that Kentucky is not now a cotton-growing state. A few bales are produced each year in the extreme southwestern corner of the state, but it is hardly regarded as a crop of sufficient importance to be worthy of notice by our people gathering agricultural statistics. The cotton worm moth is a rare insect in the state. It appears suddenly at long intervals about the electric lights of our cities, where it was extremely common September 23, 1911. Nothing was seen of it in 1912, until late in the summer when a few appeared again about the electric lights in September, and occasional specimens have been observed from time to time during early October. So far as I know the insect does not breed in the state, but simply migrates northward from southern cotton fields.

The pickle worm (*Diaphania nitidalis*) has been more destructive during the past summer than I have ever known it before. Whole plantings of cucumbers and cantaloups were so badly damaged as to be scarcely fit for market. It works upon the cucumbers when half as long as one's finger, and continues until they are of some size, the invasion being followed by a soft rot which soon extends throughout the whole fruit. It has proved injurious also to other vegetables of the same family, such as squashes and simlins.

I have had more complaints of the twig-girdler (*Oncideres cingulatus*) this year than ever before. It has been sent to me by a number of correspondents and reported injuring very badly persimmon, and hickory and pecan. Associated with the injury on pecan trees was the hickory shuck worm (*Grapholitha caryæ.*) This worm perforates the hulls, sometimes penetrating the young and soft nut, and while not always destroying the nut, seems capable of doing a good deal of mischief.

The Buffalo gnat is commonly considered a southern insect, pretty closely restricted to the bottom lands along the Mississippi River, so far as its injuries are concerned. It is sometimes very common locally in Kentucky, generally along the Mississippi in the extreme western

end of the State and also along the lower part of the Ohio River. I found it very common early last spring in Daviess County near the Ohio River. Horses working in the fields were so worried by the attacks that it was necessary to apply a mixture of lard and coal oil to keep it away. It is said to have been very much more common in this region in early days when more woodland was present. It is a serious pest still at times.

The bag worm (*Thyridopteryx ephemeræformis*) is a conspicuous Kentucky insect. At times it overruns our deciduous trees, though when least abundant it is commonly restricted to cedars and other evergreens. I have seen it in large numbers on the trees about the campus of this University, so that it became a very severe drain upon their vitality. Its parasites then appeared in immense numbers and now seem to have all but exterminated it. I have seen very few of them for several years. Trees formerly with large numbers of the sacks hanging from the twigs are now entirely free.

For a number of years I have been watching the movements of the monarch butterfly (*Anosia plexippus*). In September and early October it begins to move southward through Kentucky, coming to us from Michigan and Ohio, and as I write at my desk on sunny days during this period a constant succession of individuals is to be seen moving past my window and over the building. A careful study of the movements of the insect would afford facts of interest to entomologists. It is as regular in its migrations as are some of the warblers among the birds. On several occasions I have seen it moving southward along the shores of Lake Michigan in early September.

I will mention just two other insects, though many others have attracted my attention in one way or another during the season. The black locust is a very common tree in Kentucky. It is frequently seen in woodland pastures and is sometimes planted along the roadsides for shade. At times it is severely damaged by leaf-miners, among which the small yellow beetle with black back (*Odontota dorsalis*) is noticeable. This insect places a cluster of eggs on the leaves, from which its flat larvæ hatch and push into the interior, often occupying all of the leaflet attacked. In August the trees are frequently rendered completely brown by this insect, working with several Tineid leaf-miners. Quite frequently the trees over whole counties are embrowned at this season of the year and look as if they had been singed by fire. The injury was very noticeable in Fayette and Clark counties this year.

Among the most reliable Kentucky fruits are the different varieties of grapes of American origin. They are sometimes badly damaged by insects. This year, locally, the grape berry moth (*Polychrosis*

botrana) was common, and on some trellises the greater part of the fruit was found affected. The insect is not difficult to deal with by careful pruning, clearing away all rubbish, and spraying, as it is generally on vines that are somewhat neglected that it does mischief.

One of the most common birds about Lexington is the crow blackbird (*Quiscalus quiscula*). It begins to flock soon after it has produced its young in the early part of the season and thereafter constantly forages in the country surrounding Lexington, coming into town in the evening at dusk in immense numbers to roost about certain premises. For years thousands of these birds have passed over the Experiment Station on their way to a group of evergreen and other trees a short distance beyond the Station grounds. They sometimes become so numerous that citizens complain of them because of the litter they make and of their noise and clatter when roosting in the trees. Because of this, numbers of them have been shot at times. Some years ago I made a study of the food of the birds and found that while they undoubtedly pick up a good deal of grain, most of it is refuse, and they destroy large numbers of insects, such as June-bugs, weevils and the like, which they find on sod land. The appearance of the fall army worm in the vicinity this year led me to think that the bird might be doing good by destroying this insect, since its food is taken almost entirely from the ground. I had a number of birds shot, and on examining the contents of the stomachs found that they were feeding almost entirely on grasshoppers which had been everywhere common during the season. The thousands of birds gathering in this region must do the farmers valuable service in the destruction of these insects. I estimated that 93.8 per cent of the food consisted of insects, most of it grasshoppers and the rest fragments of beetles with traces of a few other insects. No fall army worms were found in the stomachs examined.

INSECTS OF THE YEAR 1912 IN IOWA

By R. L. WEBSTER

Following a winter of extremely low temperatures the spring of 1912 in Iowa opened late. Excess of snow during the winter made the soil quite moist when this melted, but the summer was dry over most of the state. The late summer was characterized by much rain. The following notes are extracted from the insectary and field records of the entomological section of the Iowa Agricultural Experiment Station at Ames.

Lepidosaphes ulmi Linné. Evidently due to the extremely low temperature of January, this troublesome insect received a setback from which it will not immediately recover. Early in the spring, before any growth had started, I noticed that many eggs under the oyster-shell scales were yellowish in color instead of the usual white. These eggs retained their normal shape and since I had seen similar conditions previously I thought nothing of the matter. Not all of the eggs under the scales were yellowish; many were white.

Planning to make some spraying experiments when the young scale insects were hatching I made daily observations in May on some badly infested apple trees at Ames. On one limb of an old tree at Ames I found crawling young insects May 23. Strange to say, however, I found them nowhere else on that tree, nor even in the orchard. The following day, in a badly infested orchard at Hampton, Iowa, I found no crawling scale insects, although apparently sound eggs were extremely abundant under the scales. Again, May 25, at Iowa Falls, Iowa, practically the same conditions were found. These two localities are to the north of Ames, the difference in latitude being about fifty miles for Hampton and thirty-five miles for Iowa Falls. Both these places were visited again late in June but even then there were no signs that any eggs had hatched. Moreover, outside of the one instance mentioned, not another living scale insect of this species was found at Ames.

The monthly mean temperatures for January, 1912, at Ames were 12.7° for the maximum and —6.5° for the minimum. For three weeks at the first of the year there was some very cold weather and in order to show that it may sometimes be cold in Iowa I have included here the minimum temperatures taken at Ames for the first fifteen days of January. These figures are from the Iowa Climatological service of the Weather Bureau, Report for January, 1912.

January	1	−16	January	9	− 7
	2	−18		10	−11
	3	−10		11	−19
	4	−12		12	−35
	5	−20		13	−23
	6	−18		14	+ 2
	7	−31		15	−20
	8	−10			

Carpocapsa pomonella Linné. Following an abundance of apples in 1911 the crop in 1912 in Iowa was short, being only 15 per cent of normal. This condition was favorable to the codling moth and wormy apples were abundant generally. Even where consistent spraying

was practised wormy apples were more common than usual. Such was the case around Hamburg, one of the apple centres in southwestern Iowa. But in some of the unsprayed orchards in that locality practically every apple was wormy by the first of August.

Tibicen septendecim Linné. As was expected the 17-year-cicada appeared over a large portion of southern, central and southeastern Iowa. It was not abundant at Ames, although for some weeks the woods were ringing with their notes. Since the distribution of this brood will be discussed in a paper by Professor Summers, the insect needs no further notice here.

Monostegia ignota Norton. Of the two common species of strawberry slugs in Iowa, this one has been for years the more abundant. The name as here given is incorrect, so Mr. S. A. Rohwer tells me, but I have used it tentatively until the matter of nomenclature may be straightened out. The insect was abundant in May around Ames, and also at several other points in the state, causing severe damage in some cases.

Phlegethontius sexta Johanssen. In the fall of 1910 this insect was very abundant on tomato plants at Ames, although it was heavily parasitized. Since that time, however, the larvæ have been rare. From my notes on the insect no larvæ were observed at all at Ames during 1911, but in 1912 a few were found. I am crediting this scarcity to the abundance of *Apanteles congregatus* in the fall of 1910, even though the Apanteles cocoons were themselves much parasitized by two species of hyperparasites at that time.

Peridroma margaritosa saucia Hubner. In June reports came in to the experiment station of damage to alfalfa by "army-worms" in Pottawattamie and Mills counties, in southwestern Iowa. These turned out to be the variegated cutworm, which occasionally becomes so abundant that it adopts the habits of the true army-worm. A trip to Council Bluffs June 24 revealed the fact that most of the larvæ were then about mature, and also heavily parasitized by tachinid larvæ, so the damage had practically all been done at that time. While there was considerable injury to alfalfa, this was only local.

From some of these larvæ sent to the insectary, the moths emerged in July. The same species was reared again in the insectary in the fall. A single mass of eggs collected outside August 20 hatched, and the moths were reared, these emerging early in October. Not all the larvæ in some cages have been accounted for, and some may winter as pupæ. The great majority, however, emerged in October.

Macrosiphum solanifolii Ashmead. This aphid is not generally considered as much of a potato pest in Iowa, but in July the species became excessively abundant on potatoes at Ames. The prompt

action of *Hippodamia convergens*, with the aid of certain hymenopterous parasites, checked the outbreak.

Lachnosterna spp. A serious outbreak of white grubs occurred in northeastern Iowa in 1912, corn and meadows being greatly damaged. This outbreak is to be considered elsewhere by Professor Summers, so it need not be taken up here.

PRELIMINARY REPORT OF THE COMMITTEE ON ENTOMOLOGICAL INVESTIGATIONS

By THOMAS J. HEADLEE, PH.D., *Chairman*

In accordance with the desire of the American Association of Economic Entomologists its committee on entomological investigations has collected data for the preparation of a list of projects. Any workers in Canada or in the United States who have not had a chance to contribute have either been inadvertently overlooked, or have previously refused to coöperate.

At the suggestion of several of the leading entomologists, this committee has reduced the ordinary number of questions and included one intended to furnish information for the making of a taxonomic directory.

A Remedy for Chrysanthemum Leaf Miner. During the spring and summer of 1912 a very serious outbreak of the chrysanthemum leaf miner, *Napomyza chrysanthemi* (Kowarz), occurred in two Milwaukee (Wis.) greenhouses which had imported infested chrysanthemums and marguerites from Boston. Similar injuries were reported from Chicago and other points. The growers were facing an entire loss of their blooming plants caused by complete infestation of the leaves by the mining larvæ of this fly.

While experimenting with contact insecticides for their control, the nicotine solutions, especially "Black Leaf 40" used as a spray with or without whale oil soap solution proved a complete and satisfactory control. One part of nicotine in 100 parts of water, killed the eggs and larvæ readily, as well as newly formed pupæ. The pupæ of all ages were killed with 1-200 nicotine solution. It is evident that the nicotine affects the larvæ through the leaf epidermis by osmosis. Several types of lepidopterous and coleopterous leaf miners were killed by the use of nicotine sprays in an experimental way, but time was not available for field tests. It would be advisable to test this method in the control of the blackberry leaf miner which is a serious pest in some seasons.

J. G. SANDERS, *College of Agriculture, Madison, Wis.*

The following communication was sent out:

MY DEAR SIR:—

In accordance with my duty as chairman of Committee on Entomological Investigations, I am transmitting to you the request for information formulated by this committee. The committee hopes to publish a list of the subjects of investigation in that issue of the JOURNAL OF ECONOMIC ENTOMOLOGY which comes out just previous to the next meeting, and earnestly requests the favor of an immediate reply to points 1–3. The committee would like to have you send in your statements on point 4 as soon as convenient and not later than December 1, 1912. The committee will appreciate all suggestions for "the good of the order."

Hoping that we may have your hearty cooperation, I am,

Very sincerely yours,

REQUEST FOR INFORMATION

1. What are the subjects of investigation you have now under consideration?

2. If consonant with your pleasure to answer, will you state what progress has been made on each project?

3. In what group or groups of insects are you now willing to do classification work for other members of the profession? What are the conditions under which you will do this work?

4. If you can find time please prepare a brief statement of what you believe to be the characteristic marks of worthy entomological investigation.

Please do not delay answering points 1–3 until you can discuss point 4; but answer such of 1–3 as you are willing to give information on and send your ideas on No. 4 by December 1st, 1912.

In the following list the name or names immediately following the address indicate the person or persons reporting the project, and in the absence of specific statement as to the person in charge of a given project may and probably do in most cases indicate the person or persons pursuing the investigation.

Investigations dealing with Crustacea

Mississippi, Agricultural College,—R. W. Harned.

1. The Crayfish of Mississippi.

Substantial progress in the collection of data on life history and habits of all species found and on methods of control.

Investigations dealing with Acarina

Canada, Ottawa,—C. Gordon Hewitt.

2. Ticks, especially Dermacentor spp.

North Carolina, Raleigh,—Franklin Sherman, Jr.

3. The life history, biology, food plants and methods of control of the cotton red spider, *Tetranychus bimaculatus*.

Just begun.

New York, Geneva,—P. J. Parrott.

4. Monographic study of the Eriophyidæ of New York. In immediate charge of H. E. Hodgkiss.

The maple species already listed and described.

Tennessee, Knoxville,—E. C. Cotton.

5. North American fever tick.

Well advanced.

Investigations dealing with Thysanoptera

Arizona, Phoenix,—A. W. Morrill.

6. The citrus thrips, *Euthrips citri*.

Completed this season.

Canada, Ottawa,—C. Gordon Hewitt.

7. Thrips affecting cereals.

Florida, Gainesville,—J. R. Watson.

8. Thrips on tomatoes.

Massachusetts, Amherst,—H. T. Fernald

9. Methods for the control of onion thrips on large fields.

Have not as yet found right treatment.

New Mexico, Agricultural College,—D. E. Merrill.

10. Onion thrips.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

11. An investigation of thrips on onions in New York with means of control. J. C. Faure in immediate charge.

Two thirds completed.

New York, Geneva,—P. J. Parrott.

12. The life history, habits and distribution in New York of the pear thrips, *Euthrips pyri*.

Progress in obtaining data on oviposition, pupation and activities of adults.

Investigations dealing with Mallophaga

California, Stanford University,—V. L. Kellogg.

13. Preparation of a complete host catalogue of the Mallophaga of the world, together with an examination of the conditions of distribution and species forming among the Mallophaga.

Catalogue and study complete except for the entry of about 500 records which have been made since the work began.

14. The study of a considerable collection of the Mallophaga from birds of India.

Work approaching completion.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

15. A study of the Mallophaga parasites of domestic fowls.

Nearing completion for a preliminary report.

Investigations dealing with Orthoptera

Kansas, Manhattan,—T. J. Headlee.

16. The habits and methods of destroying injurious native grasshoppers. F. B. Milliken in immediate charge.

Progress—a publication in press.

Nebraska, Lincoln,—Myron H. Swenk.

17. Grasshopper control. Lawrence Bruner in charge.

Substantial progress.

New Mexico, Agricultural College,—D. E. Merrill.

18. Grasshoppers.

New York, Geneva,—P. J. Parrott, B. B. Fulton.

19. Life histories, habits and means of controlling the tree crickets, *Oecanthus* and related species.

Completed and being prepared for publication.

Ohio, Wooster,—H. A. Gossard.

20. Grasshoppers.

Some data accumulated.

West Virginia, Morgantown,—W. E. Rumsey.

21. The control of the walking stick.

Investigations dealing with Hemiptera

Arkansas, Fayetteville,—George G. Becker.

22. The supposed immunity of Northern Spy stock to the attack of woolly aphis.

Little progress thus far.

Canada, Guelph,—Lawson Caesar.

23. Capsids attacking the fruit or foliage of the apple.

Substantial progress. Three species have been discovered during this work, a number of photographs of injury have been made and a considerable amount of data collected.

Canada, Ottawa,—C. Gordon Hewitt.

24. Capsid and aphis injuries in British Columbia.

25. The chinch bug in Ontario.

Colorado, Fort Collins,—C. P. Gillette.

26. Life histories, food plants and remedies for the plant lice of Colorado.

Well advanced.

27. Life history and methods of controlling the tomato psyllid. S. Arthur Johnson in immediate charge.

Florida, Gainesville,—J. R. Watson.

28. White fly studies.

Substantial progress.

Illinois, Urbana,—S. A. Forbes.

29. Tests on a large scale of improved methods of individual and community operation against outbreaks of the chinch bug.

Campaign this year very successful.

Iowa, Ames,—R. L. Webster.

30. Oyster shell scale, *Lepidosaphes ulmi*.

Kansas, Manhattan,—T. J. Headlee, J. W. McCulloch.

31. The life economy and better measures of controlling the chinch bug.

Substantial progress, some circulars published and a bulletin ready for press.

Kansas, Manhattan,—T. J. Headlee.

32. Control of San José scale.

Substantial progress, two reports, some circulars already published and a bulletin now ready for the press.

Maine, Orono, Edith M. Patch.

33. Ecological and morphological investigations of Aphididæ.

34. Ecological and morphological investigations of Psyllidæ.

Mississippi, Agricultural College,—R. W. Harned.

35. Scale insects of Mississippi (food habits and life history of the native species).

Progress good, some publication.

Missouri, Columbia,—Leonard Haseman.

36. The tarnished plant bug and its work on peach and other plants.
Well under way.
37. The apple leaf hopper.
Well under way.
New York, Geneva,—P. J. Parrott, H. E. Hodgkiss.
38. Life history, habits, and means of protecting pear orchards from the false tarnished plant-bug, *Lygus invitus* Say.
Almost completed.
39. A study of the activities of the late summer broods of the Pear Psylla and finding of more efficient means of control.
Principal progress in demonstrating in a large way that different stages of the first brood are susceptible to spraying mixtures.
New York, Geneva,—P. J. Parrott.
40. The life history, habits and means of controlling the grape leaf hopper. F. Z. Hartzel in immediate charge.
Progress along lines of demonstrating efficient spraying practices.
New York, Cornell University, Ithaca,—C. R. Crosby.
41. Tarnished plant bug.
New Mexico, Agricultural College,—D. E. Merrill.
42. The grape leaf hopper.
North Carolina, Raleigh,—Franklin Sherman, Jr.
43. Laundry soap in water as a remedy for aphids.
Most of serious aphids yielded readily to treatment with a mixture composed of 1/2 lb. soap in 4 gals. of water.
North Carlina, West Raleigh,—Z. P. Metcalf.
44. Life history and methods of controlling the gloomy scale, *Chrysomphalus tenebricosus* Comst.
Well started.
Ohio, Wooster,—H. A. Gossard.
45. The control of the chinch bug.
Progress satisfactory.
46. The Coccidæ of Ohio.
Progress satisfactory.
47. The control of the apple woolly aphis.
Tennessee, Knoxville,—E. C. Cotton.
48. The hog louse.
Just definitely taken up.
Virginia, Norfolk,—T. C. Johnson.
49. Life history of the spinach aphis
50. Cabbage aphis
51. Pea aphis
52. Cucumber aphis
} In charge of F. H. Chittenden.
West Virginia, Morgantown,—W. E. Rumsey.
53. The control of the apple tree aphis through the destruction of its eggs.
Lime-sulphur proved better than any other substance tried.
54. The control of the woolly aphis.
Not yet begun.

Investigations dealing with Lepidoptera

Arkansas, Fayetteville,—George G. Becker.
55. Life history and methods of control of *Sanninoidea exitiosa*.

Substantial progress.

Arizona, Phoenix,—A. W. Morrill.

56. Life history and control of the codling moth under the widely varying conditions found in Arizona.

Well under way.

Canada, Ottawa,—C. Gordon Hewitt.

57. Bionomics of the brown-tail moth in Canada.

58. Establishment of the parasites of the brown-tail moth and of the Calosoma beetles.

59. The native parasites of the fall web-worm and of the tent caterpillars in Nova Scotia and New Brunswick.

60. Life history and control of the green fruit worms (Xylina) in Nova Scotia

61. Life history and control of the eye-spotted bud moth in Nova Scotia.

62. The lesser apple worm in British Columbia.

63. Cut worms, especially in western Canada.

Colorado, Fort Collins,—C. P. Gillette.

64. Life history and better measures of controlling the codling moth in Colorado.

65. The fruit-tree leaf roller investigations. George P. Weldon in immediate charge.

Nearly ready for publication.

Connecticut, Storrs,—G. H. Lamson.

66. The use of hogs in controlling the codling moth in apple orchards.

Florida, Gainesville,—J. R. Watson.

67. *Heliothis obsoleta* on tomatoes.

68. The life history and control of *Anticarsia gemmatilis* Hbn. on velvet beans.

Indiana, Lafayette,—James Troop.

69. The life history of the codling moth for northern, central and southern Indiana.

Just begun.

70. Number of broods of the fall army worm in north and south ends of the State of Indiana.

Just begun.

Kansas, Manhattan,—T. J. Headlee, J. W. McCulloch.

71. The life economy and measures of controlling the corn ear worm.

Substantial progress, one paper and one circular published and a bulletin now ready for the press.

Missouri, Columbia,—Leonard Haseman.

72. The unspotted tentiform leaf miner of the apple.

Ready to report.

73. Peach tree borer.

Just begun.

Nebraska, Lincoln,—Myron H. Swenk.

74. Cut worm injury to Nebraska crops.

Considerable data accumulated.

New York, Geneva,—P. J. Parrott, W. J. Schoene.

75. The life history, habits and distribution of the apple and cherry eriune moths.

Completed and being prepared for publication.

New York, Albany,—E. P. Felt.

76. A study of the efficiency of spraying for the control of the codling moth.

In the Hudson Valley under normal crop conditions one thorough application results in 95–98 percent of worm free fruit.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

77. Fruit tree leaf roller.

Preliminary report has been made but further experiments in control are under way.

78. Life history and control of the codling moth in western New York. R. W. Braucher in immediate charge.

Nearly completed.

79. The larch case bearer.

Completed.

North Carolina, West Raleigh,—Z. P. Metcalf.

80. Investigations of the imported cabbage web worm, *Hellula undalis* Fabr.

Tennessee, Knoxville,—E. C. Cotton.

81. Peach tree borer.

Well along.

Utah, Logan,—E. G. Titus.

82. Life history of the codling moth.

Investigations dealing with Diptera

Canada, Guelph,—Lawson Caesar.

83. Life history, distribution in Ontario and control of the apple maggot, *Rhagoletis pomonella*.

Substantial progress.

84. Life history, distribution in Ontario of the cherry fruit flies, *Rhagoletis cingulata* and *R. fausta*.

Just well started.

Canada, Ottawa,—C. Gordon Hewitt.

85. Life history, bionomics and control of the apple maggot in Ontario, Quebec and eastern Canada.

86. Root maggots.

87. Bionomics and control of the house fly, lesser house fly and stable fly.

Connecticut, Storrs,—G. H. Lamson.

88. The use of hogs in controlling the apple maggot.

Connecticut, New Haven,—W. E. Britton.

89. The control of the mosquito nuisance in Connecticut and the effect of drainage on the salt marsh flora and yield.

A beginning made.

Indiana, Lafayette,—James Troop.

90. The life history of the Hessian fly in northern, central and southern Indiana.

Just begun.

Illinois, Urbana,—S. A. Forbes.

91. The occurrence and life history of the black flies of Illinois with particular reference to the possibility of these insects serving as agents in the transmission of pellagra.

Kansas, Manhattan,—T. J. Headlee.

92. The life economy and methods of controlling the Hessian fly.

Substantial progress, a paper and some press bulletins already published, a bulletin now in press.

Massachusetts, Amherst,—H. T. Fernald.

93. Methods for the control of onion maggot on large fields.

Do not as yet appear to have found the right line of treatment.

New Hampshire, Durham,—W. C. O'Kane, C. H. Hadley, Jr.

94. The apple maggot.

Practically complete.

95. The control of root maggots by the use of insecticides.

96. The control of black flies, deer flies and midges.

Substantial progress, will complete in another year.

New York, Albany,—E. P. Felt.

97. A monographic study of the biology and the taxonomy of the gall midges.

Well along, largely in manuscript.

New York, Geneva,—P. J. Parrott.

98. The life history, habits and means of controlling the grape midge. F. Z. Hartzell in immediate charge.

99. Life history and habits of the Hessian fly (in cooperation with the U. S. Bureau of Entomology.)

100. The life history, habits and methods of control of the cabbage maggot. This involves a special study of the reaction of the puparia to heat and desiccation, and of the methods of protecting seed beds. W. J. Schoene in immediate charge.

Completed and being prepared for publication.

Ohio, Wooster, H. A. Gossard.

101. Occurrence and seasonal history of the Hessian fly.

102. The wheat leaf miner, *Agromyza parvicornis*.

Ready to report.

Investigations dealing with Coleoptera

Alabama, Auburn,—W. E. Hinds.

103. The life history and control of the rice or black weevil, *Calandra oryza*.

Life history worked out and valuable information gained as to the possibility of greatly reducing the injury done by the species through selection of seed corn that shall produce a crop characterized by a long tight-fitting shuck. Another series of control experiments using carbon bisulphide should be completed by January 1.

Arizona, Phoenix,—A. W. Morrill.

104. Experiments in the control by means of arsenicals of the "corrupted Lady bird" on beans, *Epilachna corrupta*.

Completed during 1913.

Arkansas, Fayetteville,—George G. Becker.

105. Life history, habits and methods of control of *Saperda candida*. This is really two projects; (1) life history and habits (2) the measures of control.

The first is just begun and in the second a large amount of data has been accumulated and will soon be able to recommend efficient measures.

Canada, Ottawa,—C. Gordon Hewitt.

106. Life history and control of the plum curculio in Quebec.

107. Life history and control of the apple curculio in Quebec.

108. Life history and control of the *Lpida*

Colorado, Fort Collins,—C. P. Gillette.

109. The life history and practicable means of controlling *Epilachna corrupta* Muls. S. Arthur Johnson in immediate charge.

Connecticut, New Haven,—W. E. Britton.

110. The life history and habits of the walnut weevil, *Conotrachelus juglandis* LeC.

Completed and about ready for publication.

111. The life history, damage and prevention of the white pine weevil in Connecticut.

A beginning made.

Illinois, Urbana,—S. A. Forbes.

112. Life history of the species of Lachnosterna (white grubs), the conditions bringing outbreaks on, and the practical use of insect and plant parasites in their control.

Complete cycle of *L. implicita* and *inversa* recently worked out.

Massachusetts, Amherst,—H. T. Fernald.

113. Methods for the control of wire worms.

Progress satisfactory.

Mississippi, Agricultural College,—R. W. Harned.

114. The boll weevil (testing powdered arsenate of lead against this species and studying its spread within the limits of the state).

Missouri, Columbia,—Leonard Haseman.

115. The hickory twig girdler.

Ready to report.

116. The striped cucumber beetle.

Just begun.

117. The clover leaf weevil.

Just begun.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

118. Means of controlling the elm leaf beetle.

Completed.

New York, Geneva,—P. J. Parrott.

119. The life history and methods of controlling the rose chafer.

F. Z. Hartzell in immediate charge.

120. The life history, habits and methods of controlling the grape root worm.

F. Z. Hartzell in immediate charge.

North Carolina, West Raleigh,—Z. P. Metcalf.

121. Biological investigations of *Sphenophorous callosus* and other injurious members of this genus occurring in North Carolina.

Practically completed.

Ohio, Wooster,—H. A. Gossard.

122. Bark beetles (fruit?)

Well along.

123. Life histories and control of white grubs.

Little real progress.

Utah, Logan,—E. G. Titus.

124. The life history of the alfalfa weevil.

Well along.

Virginia, Norfolk,—T. C. Johnson.

125. The bean weevil
126. The Colorado potato beetle } F. H. Chittenden in immediate charge.

Investigations dealing with Hymenoptera

Arizona, Phoenix,—A. W. Morrill.

127. Ant control, *Pogonomyrmex barbata*.

Will be completed next season.

Canada, Ottawa,—C. Gordon Hewitt.

128. The spruce bud worm.

129. The larch saw fly.

Connecticut, New Haven,—W. E. Britton.

130. A new saw fly pest of the blackberry in Connecticut.

Completed and about ready for publication.

Colorado, University of, Boulder,—T. D. A. Cockerell.

131. Bees (Apoidea) of the world.
Substantial progress—a large part already published.
Iowa, Ames,—R. L. Webster.
132. Two species of strawberry slugs, *Empria maculata* and *Empria* sp.
Maryland, College Park,—A. B. Gahan.
133. Classification and host relations of the *Braconida*, sub-family *Opiinæ*
Classification of described North American species of the group fairly well in hand and some progress made in other lines.
New York, Geneva,—P. J. Parrott, B. B. Fulton.
134. Life history, habits and methods of controlling the cherry saw fly leaf miner, *Profenusa collaris* MacG.
135. Distribution, life history and methods of controlling *Polydrosus impressifrons*.
W. J. Schoene in immediate charge.
New York, Cornell University, Ithaca,—C. R. Crosby.
136. Isosomas.
Utah, Logan,—E. G. Titus.
137. The life history of the wheat straw worm.

Investigations dealing with groups of insects or with insecticides or with both

Alabama, Auburn,—W. E. Hinds.
138. Carbon bisulphide and hydrocyanic acid gas as insecticides.
Substantial progress.
California, Stanford University,—V. L. Kellogg.
139. Certain prolonged experimental studies of inheritance in insects and the consideration of certain other bionomic factors in insect evolution.
Results of seven or eight years study of inheritance in silk worms already published.
Canada, Ottawa,—C. Gordon Hewitt.
140. Life histories of miscellaneous insects.
Colorado, Fort Collins,—C. P. Gillette.
141. Insect control through treatment of their eggs.
Much data collected and some of it published.
Colorado, University of, Boulder,—Theo. D. A. Cockerell.
142. Insect fauna of Colorado.
Substantial progress.
143. Fossil insects.
Data accumulating.
Connecticut, New Haven,—W. E. Britton.
144. Insects attacking the white pine in Connecticut.
A beginning made.
Connecticut, Storrs,—G. H. Lamson.
145. Insects that attack cucurbits.
146. Insects that attack peach.
Iowa, Ames,—R. L. Webster.
147. Potato insects.
Kansas, Manhattan,—T. J. Headlee.
148. The relation of climate to injurious insects.
Some progress, one paper published and further data accumulated.
149. The local life economy of the codling moth and curculio, *Conotrachelus nenuphar* Hbst, and spraying for their control.

Substantial progress. One general bulletin including some data published, much data accumulated and a paper on brood study of the former ready for publication.

150. The life economy and measures of controlling mill and stored grain insects. George A. Dean in immediate charge.

Substantial. A paper on high temperature as a means of controlling mill insects already published and a bulletin ready for the press.

Louisiana, Baton Rouge, —E. S. Tucker.

151. Insects affecting stored rice.

Progress has been made in determining the life history of the principal species and their resistance to fumigating agents under warehouse conditions.

Massachusetts, Amherst,—H. T. Fernald.

152. A study of the causes producing the burning of foliage by insecticides.

Progress satisfactory.

153. Investigations of the real amount of benefit obtained by the work of the different groups of parasites.

Progress satisfactory.

154. Distribution limits of pests in Massachusetts.

Progress satisfactory.

155. Strength of fumigation safe on different greenhouse crops as compared with strength necessary for destruction of the pests.

Progress satisfactory.

Michigan, East Lansing,—R. H. Pettit.

156. How contact insecticides kill. E. G. Shafer in immediate charge.

Substantial progress. One bulletin published and another ready.

157. The life histories and control of various fruit and field crop insects.

Much data accumulated.

158. The life histories and control of insects injurious to Michigan forests.

Much data accumulated.

Mississippi, Agricultural College, —R. W. Harned.

159. Insects affecting pecans (mainly life history studies).

Michigan, Detroit,—Parke, Davis & Co.

160. Testing penetrating power of carbon disulphide and other gases in connection with killing shade tree borers.

161. The feasibility of exterminating insects by inoculating the plant.

Nebraska, Lincoln,—Mryon H. Swenk.

162. The prairie dog.

163. The rôle of insects in tripping alfalfa blossoms and the subsequent effect of such tripping on the size of the seed crop.

Progress satisfactory.

164. A monographic account of the insect enemies of alfalfa.

Progress satisfactory.

New Hampshire, Durham,—W. C. O'Kane.

165. Insect outbreaks (a provision to take advantage of the unusual opportunities for study offered by these outbreaks).

166. A determination of the amount of arsenic left on fruit, foliage and grass following applications of sprays.

Substantial progress.

167. Museum work (a provision for increase and care of insect collections).

New York, Albany,—E. P. Felt.

168. Shade and forest tree insects.

Data have been accumulated to show that on the more valuable trees hickory bark borer may be destroyed by use of insecticides after the females have entered the trees.

169. The effect of petroleum on dormant trees.

New York, Cornell University, Ithaca. Glenn W. Herrick.

170. Investigation of clover pests with means of control.

Just begun.

171. Investigation of the life histories of insects injurious to hops with methods of control. F. W. Pettey in immediate charge.

Just begun.

Ohio, Wooster,—H. A. Gossard.

172. Peach and apple orchard spraying and its effect on insect pests.

173. Collections and exhibits.

174. Miscellaneous life histories.

175. Mill fumigation.

Much data accumulated.

176. Efficiency of different spraying nozzles.

Progress substantial. Bulletin now in press.

Utah, Logan.—E. G. Titus.

177. Arsenical poisoning of fruit trees.

Well along.

West Virginia, Morgantown, W. E. Rumsey.

178. The control of the apple and peach tree borers.

Progress satisfactory.

Taxonomic Directory

Thysanoptera

W. E. Hinds, Auburn, Ala., will classify for privilege of retaining duplicates and of naming and describing the new species.

Mallophaga

V. L. Kellogg, Stanford University, Cal., will classify when seedings are of sufficient size to make probable the discovery of new species, or of interesting new records of distribution, and when in small lots if material has been taken from unfamiliar birds, or from birds of the remote geographical regions.

Orthoptera

B. H. Walden, New Haven, Conn., will classify in so far as other work will permit *Membracidæ*, *Jassidæ*, *Cercopidæ* and *Fulgoridæ*.

Z. P. Metcalf, West Raleigh, N. C., will classify for permission to retain new and unusual forms for further study, and to dispose of a fair number of such forms as he may see fit.

Jassidæ

E. D. Ball, Logan, Utah, will classify North American forms under the usual conditions.

Aphididæ

C. P. Gillette, Fort Collins, Colo., will classify provided data on food plants and date and location of capture are furnished, and the privilege of retaining the specimens of special interest when there are duplicates.

Aphididæ and *Psyllidæ*

Edith M. Patch, Orono, Maine, will classify on receipt of mature material in good condition with record of food plant accurately determined on which the species developed.

Aleyrodidæ

J. R. Watson, Gainesville, Fla.

A. W. Morrill, Phoenix, Ariz., will classify for permission to retain specimens if desired.

Coccidæ and *Aleyrodidæ*

W. E. Britton, New Haven, Conn., will classify in so far as other work will permit.

Coccidæ

R. H. Pettit, East Lansing, Mich., will classify in so far as other work will permit.

Chironomidæ and *Mycetophilidæ*

O. A. Johannsen, Cornell University, Ithaca, N. Y., will classify for the privilege of retaining desiderata.

Ilonididæ

E. P. Felt, State Education Building, Albany, N. Y., will classify provided the midges are new, from new localities or have been reared and food record is available.

Megastigmus

C. R. Crosby, Cornell University, Ithaca, N. Y.

Aphidiinæ and *Opiinæ*, sub-families of *Braconidæ*

A. B. Gahan, College Park, Md., will classify on condition that specimens may be retained if desired.

Sphecidæ

H. T. Fernald, Amherst, Mass., will classify provided work be not required immediately on receipt of specimens. Assistant will classify *Elidinæ* and graduate students the sub-family *Aporinæ* of the family *Psammocharidæ* (*Pompilidæ*).

Apoidea

E. G. Titus, Logan, Utah. For permission to retain types and specimens not present in his collection.

Myron H. Swenk, Lincoln, Neb., will classify members of this group from Nebraska, and any North American member of the following genera—*Colletes*, *Nomada* and *Anthidium*.

PRELIMINARY LIST OF THE SCALE INSECTS OF SOUTH CAROLINA WITH SOME NOTES ON THE BEHAVIOR OF LECANIUM QUERCIFEX FITCH

By Wilson P. Gee

No previous systematic attempt seems ever to have been made to collect and identify the scale insects of South Carolina, and except for specimens which have found their way into the collections of workers in other states, there are no records of just what *Coccidæ* occur there. During the past year and a half the writer has attempted a partial collection and classification of the scales of this state, and has been able to secure at least the more generally distributed of these. He wishes to acknowledge here his appreciation of the ready response of Prof. J. G. Sanders, Department of Entomology, University of Wisconsin, to the request for the check identification of all of the soft-scale insects in this list, and to Mr. E. R. Sasscer, Bureau of Entomology, Washington, D. C., for a similar service in regard to the *Diaspine* scales.

The following is a list of the scale insects with their host plants.

1* *Chrysomphalus aonidum*, Linn. on Palm.
2* *Chrysomphalus dictyospermi* Morg. on Sabal Palm.
3 *Chrysomphalus tenebricosus* Comst. on Acer sp.
4* *Aspidiotus hederæ* Vall. on *Cycas revoluta*.
5 *Aspidiotus forbesi* Johns on Peach.
6 *Aspidiotus perniciosus* Comst. on Peach, Plum, Apple, Pear, Rose, and Cherry.
7 *Lepidosaphes beckii* Newm. on Fig.
8 *Lepidosaphes ulmi* Linn. on *Pyrus malus*.
9 *Chionaspis furfura* Fitch on *Pyrus malus*.
10 *Chionaspis euonymi* Comst. on *Euonymus japonicus*.
11* *Parlatoria pergandei* var. close to *camelliæ* on *Euonymus japonicus*.
12* *Parlatoria pergandei* Comst. on *Citrus limonia*.
13 *Fiorina theæ* Green on *Euonymus japonicus*.
14 *Lecaniodiaspis tessellata* Ckll. on Persimmon.
15 *Toumeyella liriodendri* Gmel. on *Liriodendron tulipifera*.
16 *Saissetia hemisphaerica* Targ. on Persea and *Cycas revoluta*.
17 *Pulvinaria vitis* Linn. on Acer sp.
18 *Pulvinaria acericola* Walsh and Riley on Acer sp.
19 *Pulvinaria camellicola* (?) on *Cornus florida*.
20 *Lecanium corni* Bouche on Elm.
21 *Lecanium nigrofasciatum* Pergande on Plum.
22 *Lecanium quercifex* Fitch on *Quercus aquatica*.
23 *Aulacaspis rosæ* Bouche on Rose.
24* *Coccus hesperidum* on Laurel and Cerimon.
25* *Pseudococcus citri* on *Citrus aurantium*.
26 *Pseudophillipia quaintancei* Ckll. on Pine.

* Greenhouse species.

General Behavior of Young of Lecanium quercifex Fitch. Eggs of this species were hatching May 15, in such abundance as to afford ample material for the study of some features of its behavior. While not exhaustive in character, many of these results are new and of considerable interest in the explanation of certain activities of not alone this species of scale insects, but also many related ones.

Phototaxis. To light of a 16 candle power intensity, the young insects showed a very marked positive reaction, orientation being very decidedly parallel to the direction of the rays of light. A very few specimens seemed entirely indifferent to the effect of the light rays, but taken as a whole, the reaction reminds one very much of the effect that the electric current has on Paramecium as described by Jennings.[1] Almost as soon as the light is placed at the other end of the dish, the direction of the movement of the scale insect is reversed and it again moves in the direction of the source of light. The scales of this form occur towards the outer portions of the twigs on the newer wood, and the light reactions of the insect are no doubt an important factor

[1] Jennings, H. S. Behavior of the Lower Organisms. New York, 1906.

in determining this, since the stronger light is to be found towards the tips of the branches.

Geotaxis. When placed on a thin cork board, in a vertical position, the young scale insects began climbing upward against the direction of gravity. This did not continue in all cases until the form had reached the top of the board, but many of the specimens seemed to stop when they reached a height of six or eight inches, though several continued to the top of the board, twelve inches in height. This method of reaction, crawling upward, or *negative geotaxis*, affords us another factor in the assistance of the light in aiding the young scale insects to reach the newer portions of the growth of the branch, since this part usually projects upward.

Chemotaxis. A very small amount of strong hydrochloric acid, nitric acid, and 95 per cent alcohol were placed in the midst of a large number of young scales on a glass slide, and their movements observed under a binocular. To each of these substances all of the young scales showed a very marked negatively chemotactic response. It would be interesting to test out the effect of a weak tannic acid solution in this relation, and also an extract of the juices of the twigs of the oak, where we would expect a positive reaction; but though this was the intention of the writer, the matter was overlooked until all of the young scales had become old enough to have fixed themselves in their places on the tree.

Thigmotaxis. The young scale insects show very strongly positive thigmotactic propensities. A young nymph which had become turned on its dorsal surface was observed to juggle an unhatched egg, much as a clown would a ball, moving it about with its legs from nine o'clock one morning until five o'clock that afternoon. Observations were discontinued at that time for the day; but the next morning, the performance was still in progress, and continued until about two o'clock that afternoon. At that time the young scale emerged from the egg and it was only with difficulty that the newly emerged individual could escape from the grasp of its young foster-parent. All of this misspent energy came from the attempt of the form to "right" itself, and having caught hold of the egg in its efforts to do this, it lacked sufficient organization of its nervous system to profit from an experience of this kind and continued its futile efforts in this direction until the hatching of the egg relieved it of the object of its misdirected energies. When placed upon their dorsal surfaces they grasp very quickly and cling tightly to such objects held out to them as the fibres of a camel's hair brush, small straws, etc. This positive thigmotaxis is, of course, highly adaptive in nature, and serves to keep the animal in contact with the twig on which it has hatched and will continue to spend its further existence.

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DECEMBER, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The transmission of diseases affecting man by insects has been regarded, up to recent years, as being limited in considerable measure to tropical or sub-tropical regions. Successive discoveries have led to a modification of this opinion, and the recently demonstrated connection between the deadly infantile paralysis and the stable fly still further emphasizes the danger of too intimate association with certain Hexapoda, especially Diptera. This discovery made by the entomologist working with the medical man is a most important contribution to knowledge and of incalculable value in the successful control of one of the more deadly infections to which man is subject. Similar investigations of relations which may possibly exist between obscure diseases and insects is most advisable and is an exceedingly promising field for future work.

A correct biology is a postulate of efficient practical entomology. The great demand for economic work has reacted upon insect biology and many investigators in widely separated sections of the country have been stimulated to undertake the elucidation of special problems. Our European confreres have not overlooked this field; pedogenesis and polyembryony were demonstrated abroad and confirmed in this country. The same is true of parasites ovipositing in the egg and an arrested development making possible the nourishment and growth of the Hymenopteron at the expense of the larval host. It is a striking coincidence that two groups of American investigators, whose papers appear in this issue, should work out the same problem on opposite borders of this country and demonstrate the occurrence of this peculiar life history in representatives of two of the great families of the parasitic Hymenoptera, namely the Chalcididæ and the Braconidæ, while the earlier work of Marchal, alluded to above, showed the same to be true of the Proctotrypidæ. Another striking instance along the same line is the confirmation by American writers, of the peculiar oviposition habits of certain Tachinid flies first worked out by a Japanese student and for a time deemed almost incredible. These facts are most interesting from a scientific standpoint and are frequently

of material service in applied work. It is gratifying to note that American entomologists are not overlooking the value of research in an attempt to obtain immediate results. Those who have added to the sum of human knowledge are to be congratulated upon their good fortune, while all Americans should realize that we have in the Bureau of Entomology at Washington, a peculiarly efficient research organization which reflects great credit upon its gifted chief.

Work upon insecticides, aside from general field comparisons, has received too little attention from the economic biologist. We are dealing with living organisms, and while the percentage of poison in a given insecticide and the relative activity of that poison from a mechanical standpoint is most valuable, still there should be some knowledge of the reaction of the poison upon the living insect. One American student has thrown much light on how certain insecticides kill, and in this issue we print a discussion of the possibilities and probabilities of establishing some such criterion as a poison exponent based upon the reaction of the insect under recorded conditions to standard amounts of various poisons. The inquiry is most praiseworthy and should be extended along several lines in a search for some practical test which will give much more accurate information than the comparatively gross field experiments which have been our principal source of information in the past.

Reviews

26th Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois, by S. A. FORBES pp. 1–160, figs. 42. 1912.

The increasing importance of shade tree and shrub pests is shown by the discussion at the outset of some 27 species occupying 60 printed pages. We note the absence in this list of the false maple scale, *Phenacoccus acericola* King, a species more generally injurious to hard maples in the vicinity of New York City than the cottony maple scale. The sugar maple borer is another New York pest which escapes notice. A chapter by Mr. Hart is devoted to miscellaneous economic insects and gives a particularly valuable discussion of the green fruit worms and their identity. There is an excellent opportunity for more work on these closely allied insects. The remainder of the report is devoted to the more important insects of truck farms and vegetable gardens, followed by directions for the preparation and use of the standard insecticides. The discussions are brief, practical, and the text well illustrated, a number of figures being original.

A Preliminary Report on the Alfalfa Weevil, by F. M. WEBSTER, U. S. Dep't. of Agric., Bur. of Ent., Bul. 112, pp. 1–47, figs. 27, pls. 13. 1912.

This preliminary report summarizes the earlier work against the pest, records the appearance of the clover leaf weevil, *Hypera punctata* Fabr. between the Rocky and Cascade Mountains and discusses the life history, habits and methods of control of the alfalfa weevil. The employment of an ordinary street sweeper and of wire brushes, apparently a modification of the horse rake, was found of much service in crushing the larvæ and pupæ, though somewhat expensive. A specially interesting chapter is that devoted to the natural enemies, particularly the portion relating to imported forms. Two egg parasites and five larval and pupal enemies were introduced from Italy through the agency of Mr. W. F. Fiske early in 1911. The outcome of these importations will be watched with much interest by economic entomologists. The bulletin is admirably illustrated with a large series of original line and process figures.

Insect Pests of the Lesser Antilles, by H. A. Ballou. Imperial Department of Agriculture for the West Indies, Pamphlet, Ser. 71, pp. 210, figs. 185. 1912.

This useful compilation, designed, in the words of the author: "To present in plain and simple language, a brief general account of our present knowledge of some of the principal insect and mite pests of the crops grown in the Lesser Antilles; also of the pests attacking man and domestic animals as well as those of the household" will appeal particularly to entomologists located in Tropical and Subtropical regions. The comprehensive nature of the work involves brief notices of many species, following a short chapter on the natural history of insects and another giving the characteristics of the more important orders. The grouping will appeal to the agriculturist, since it is designed to facilitate the recognition and control of the various forms attacking plants or animals. Considerable space relatively is given to a discussion of mosquitoes and fleas, an indication of their importance in that latitude.

In treating of the control of insects, the author rightly emphasizes first of all, the value of preventive measures and then gives detailed information respecting the various insecticides and their method of operation. The author discusses and recommends to a limited extent, the use of corrosive sublimate and phosphorus, two extremely dangerous poisons rarely advised by entomologists in temperate regions. Many of the illustrations are excellent, not a few being from American Government or State publications while some are rather crude. The author is to be congratulated upon having prepared such a convenient compilation.

Scientific Notes

Stable Fly and Infantile Paralysis. The successful transmission of infantile paralysis in monkeys through the bite of the blood-sucking stable fly *Stomoxys calcitrans* has been announced by Prof. M. J. Rosenau of the Harvard Medical School and C. H. Brues of the Bussey Institution, Harvard University, and their results have been confirmed by Dr. J. F. Anderson of the Public Health and Marine-Hospital Service.

The hypothesis advanced last year by Brues and Sheppard that the stable fly is the carrier of this disease has thus been given experimental proof, although it is still possible that other channels of infection may exist. With the exception of the investigations of Doctor Anderson, the work was done under the auspices of the Massachusetts State Board of Health, and the announcement appears in the *Monthly Bulletin* of that board for September, 1912.

Note on a Parasite of White-grubs. While following the plow in the spring of 1909, to learn the degree of infestation by white-grubs in fields near Aurora and Bloomington, Ill., the writer noticed in the earth many cocoons resembling those of *Tiphia inornata*, but somewhat larger, more nearly elliptical, and without the neck-like constriction near one end often seen in Tiphia cocoons. They were also much smoother, and lacked the loose fluffy coating of silk characteristic of Tiphia. The remains of Lachnosterna larvæ, especially parts of the mandibles and other portions of the head, and in some cases the dried skin, were attached to very many of these cocoons. From a number of them collected near Bloomington, imagos emerged in the early summer of 1909, and were identified by Charles A. Hart as *Myzine sexcincta* Fab.

Myzine cocoons have now been taken in considerable numbers behind the plow, in central and northern Illinios, during the years 1910, 1911, and 1912, over 75 per-cent of them with parts of white-grubs attached. Hence, while this insect has not been bred at the insectary direct from white-grubs, there can be little or no doubt that it is a parasite upon them.

In some field collections Myzine cocoons have outnumbered those of Tiphia, sometimes, no doubt, because they were more numerous in the soil, but sometimes apparently because they generally lie nearer the surface than those of Tiphia, and hence are more frequently thrown out in shallow plowing. In a field near Galesburg, for example, plowed for experiments with the corn root-aphis, careful note was made of all insects exposed, with the following result as to white-grubs and their parasites: In four plots of one acre each plowed to the depth of four inches, 75 cocoons of Myzine were collected, 41 of Tiphia, and 365 of living white-grubs; but in a single acre plowed six inches deep and containing 48 living grubs, the Myzine and Tiphia counts were 2 and 9, respectively.

In central Illinois large numbers of adult Myzine may usually be seen, from the middle of June to the latter part of August, about blossoms of sweet-clover (*Melilotus alba*), the males greatly outnumbering the females in this situation; and females have been noticed several times in corn fields, either crawling on the ground or flying just above it. The males, on the other hand, like other members of their family, have the habit of resting in numbers on the tops of weeds or grass at night. Twenty-two of them were taken, for example, from the top of a large ragweed with one sweep of a net.

Several hundred Myzine cocoons have been found during the last three years from plowed fields in central Illinois. Generally speaking, they are, in this district, nearly as abundant as Tiphia cocoons, and they must be an important factor in reducing the number of white-grubs.

W. P. FLINT and G. E. SANDERS.

Fall Army Worm (*Laphygma frugiperda* Sm. & Abb.). I notice that Dr. Felt reports that this insect was unusually abundant during September and October in the vicinity of New York City. I have never known this species to be as abundant in Indiana in the past 25 years, as it was this fall. It was first reported from South Bend the first week of September, and following that, specimens were received from about twenty different sections of the state, the last one being received on November 7th. Adults were bred from the first lot of larvæ on October 8 and the moths were found in the field, in other localities, as late as October 28. Only one Tachina fly was bred from fifty larvæ, thus showing that a comparatively small per cent of them was parasitized. The greater amount of damage was done to newly-sowed alfalfa, although they did much damage to wheat, rye, and timothy.

J. TROOP.

FEDERAL QUARANTINE NOTICE

Gipsy and brown-tail moths. Under authority of the Plant Quarantine Act, Acting Secretary of Agriculture, Willet M. Hays has declared a quarantine for the brown-tail moth against the following localities: All towns between the Atlantic Ocean and Robbinston, Charlotte, Cooper, Plantation XIX, Wesley, Plantation XXXI, Plantation XXX, Devereaux, Plantations XXVIII, XXXIII, and XXXII, Milford, Alton, Bradford, Atkinson, Dover, Sangerville, Parkman, Wellington, Brighton, Solon, Embden, Anson, New Vineyard, Farmington, Temple, Wilton, Carthage, Mexico, Rumford, Newry, Riley, *Maine;* Shelburne, Gorham, Randolph, Jefferson, Whitefield, Dalton, Littleton, and Monroe, *New Hampshire;* Ryegate, Newbury, Bradford, Fairlee, Thetford, Norwich, Hartford, Hartland, Windsor, Weathersfield, Springfield, Rockingham, Westminster, Putney, Dummerston, Brattleboro, and Guilford, *Vermont;* Leyden, Greenfield, Deerfield, Whately, Hatfield, Northampton, Easthampton, Holyoke, West Springfield, Springfield, Longmeadow, East Longmeadow, and Hampden, *Massachusetts;* Stafford, Union, Woodstock, Pomfret, and Killingly, *Connecticut;* Foster, Coventry, West Greenwich, East Greenwich, and North Kingston, *Rhode Island.* In addition to these the towns of North Adams and Clarksburg, *Massachusetts*, are also infested and are included in the quarantine area.

This quarantine applies to all deciduous trees or shrubs, including all deciduous field-grown florists' stock, vines, cuttings, grafts and scions.

The following territory is quarantined for the gipsy moth:

All the territory between (and including) the towns named and the Atlantic Ocean, as follows: Georgetown, Westport, Edgecomb, Damariscotta, Nobleborough, Newcastle, Alna, Whitefield, Chelsea, Pittston, Dresden, Richmond, Bowdoin, Webster, Lewiston, Auburn, Poland, Casco, Raymond, Windham, Standish, Limington, Cornish, and Porter, *Maine;* Freedom, Ossipee, Tuftonborough, Meredith, New Hampton, Hill, Danbury, Wilmot, Salisbury, Warner, Henniker, Hillsborough, Antrim, Hancock, Dublin, Troy, Richmond, and Winchester, *New Hampshire*, Warwick, Orange, Athol, Petersham, Barre, Oakham, Spencer, Sturbridge, Charlton, Dudley, and Webster, *Massachusetts;* Burrillville, Gloucester, Johnston, Cranston, Warwick, and North Kingston, *Rhode Island;* excepting the towns of Newport, Tiverton, and Little Compton, *Rhode Island;* Westport, Fall River, Somerset, Dighton, Freetown, Dartmouth, Fairhaven, and Mattapoisett, *Massachusetts*.

The gipsy moth quarantine applies to coniferous trees such as spruce, fir, hemlock, pine, juniper (cedar), and arbor-vitæ (white cedar), known and described as "Christmas trees," and parts thereof, and decorative plants such as holly and laurel, known and described as "Christmas greens or greenery."

Also forest plant products including logs, tan bark, posts, poles, railroad ties, cordwood, and lumber, and field-grown florists' stock, trees, shrubs, vines, cuttings, and other plants and plant products for planting or propagation excepting buds, fruit pits, seeds of fruit, and ornamental trees and shrubs, field, vegetable and flower seeds, bedding plants and other herbaceous plants and roots.

The above plants or plant products are not allowed to move interstate to any point outside the quarantined areas unless and until such have been inspected by the United States Department of Agriculture and pronounced free from the insects against which quarantine has been declared.

Current Notes

Conducted by the Associate Editor

Mr. J. L. Webb of the Bureau of Entomology, is now located at Crowley, La., where he is engaged in Southern Field Crop Investigations.

Mr. Bentley B. Fulton has been appointed assistant entomologist of the New York Agricultural Experiment Station at Geneva.

Mr. H. J. Webb has been appointed assistant in Entomology, at the Utah Agricultural College and Experiment Station.

Mr. W. H. Goodwin, Assistant Entomologist of the Ohio Station, is taking up work at the Ohio State University leading to the Master's Degree.

Mr. W. R. Thompson of Cornell University, has been detailed by Dr. L. O. Howard of the Bureau of Entomology, to study the Mediterranean fruit fly in Sicily, where he is now engaged in this work.

Mr. D. E. Fink of the department of Entomology, Cornell University, has accepted a position with the Bureau of Entomology, and is now located in Norfolk, Virginia, studying the pests of vegetables.

Mr. W. P. Gee has resigned as assistant professor of Entomology at Clemson College and Station, South Carolina, to take up graduate work at the University of California.

Miss Orrel M. Andrews of Fairmount College has been appointed Research Fellow in the Department of Entomology of the University of Kansas for the coming year.

Mr. A. G. Ruggles, Assistant Entomologist at the Minnesota Experiment Station is absent from the Station on a seven months' leave of absence, being engaged during that time by the Pennsylvania Chestnut Tree Disease Commission, with headquarters at Philadelphia.

Mr. L. M. Sedgwick of Kansas City, Mo., has presented a valuable collection of tropical insects to the Entomological Museum of the University of Kansas. When mounted and placed in cabinets it will be known as the "L. M. Sedgwick Collection."

Mr. W. F. Schlupp, who spent several months with the Entomological Department of the Ohio Station during the summer, has taken up work with the Bureau of Plant Pathology, U. S. D. A., and is making an investigation of Ohio with reference to the chestnut blight.

Mr. J. S. Houser of the Ohio Station, received his Master's Degree in Science from Cornell University in June. He has recently been raised to the rank of associate entomologist.

Mr. R. D. Whitmarsh, Assistant Entomologist of the Ohio Station, has a leave of absence for a few months, and the first of November goes to Columbus for post-graduate study leading to the Doctor's Degree from the Ohio State University.

Mr. J. L. King of the Ohio Station, who has had a laboratory at Gypsum in the orcharding district along the lake shore during the spring, summer and fall months, will remove his headquarters to Wooster for the winter.

Mr. Oscar C. Bartlett, B. S. 1909, Ph. D. 1912, and formerly laboratory assistant Massachusetts Agricultural College, has been appointed Assistant State Entomologist of Arizona. His address hereafter will be Phoenix, Ariz.

Dr. Guy C. Crampton, Associate Professor of Entomology at the Massachusetts Agricultural College, was present at the meetings of the Second International Congress of Entomology at Oxford, England, last summer. By some error on the part of the secretaries, his residence was given as Glasgow, Scotland.

The publication of the Bulletin of the Brooklyn Entomological Society has been resumed after a lapse of twenty-eight years. The first number bears the date of October, 1912, and is Vol. VIII, No. 1. It has twenty pages and one plate. Short articles and collector's notes will be made a special feature of this Bulletin.

Dr. Robert Matheson has resigned from the Department of Entomology of Cornell University to accept a position as Provincial Entomologist of Nova Scotia. He is to be located at Truro. Most of his work is economic, but he will give some attention to teaching during the winter in the Agricultural College at Truro.

Mr. G. H. Grosvenor, an English Entomologist, who was Assistant Secretary of the recent International Entomological Congress, was drowned off the Cornish Coast while trying to save the life of another.

P. W. Mason, a recent graduate from the Michigan Agricultural College, has taken a position as Assistant Entomologist in Purdue University, LaFayette, Ind. Mr. Mason served three years as assistant to Prof. R. H. Pettit, at the Michigan College and goes to his new work well equipped.

Dr. Oskar A. Johannsen, Entomologist of the Maine Agricultural Experiment Station, has resigned to accept the appointment of Assistant Professor of Biology in Cornell University in place of Doctor Matheson, resigned. Doctor Johannsen has already moved to Ithaca, N. Y., where mail should be sent to him. His present address is 417 East Buffalo Street.

Paul Hayhurst, Entomologist of the Arkansas College and Station, resigned several months ago and is now studying horticulture at the University of Illinois. Mr. George G. Becker, formerly assistant in the department, has been made Acting Entomologist and Acting State Nursery Inspector.

Mr. C. L. Metcalf, M. S., of the Ohio State University, has entered upon his duties as Assistant Entomologist, of the North Carolina State Department of Agriculture at Raleigh, succeeding his brother Z. P. Metcalf, who is now Entomologist of the North Carolina Agricultural College and Experiment Station at West Raleigh.

Mr. W. R. McConnell, Assistant in charge of the department of Zoölogy at the Pennsylvania State College, resigned at the close of the last college year to accept a position in the Division of Cereal and Forage Insects of the Bureau of Entomology. He is now located at Greenwood, Mass.

Mr. W. V. King of the Bureau of Entomology, who was formerly engaged in the investigation of the spotted fever tick in Montana and later in an investigation of the possible pellagra carriers in South Carolina, has recently registered in the school of Tropical Medicines in Tulane University, taking as his major subject, Medical Entomology, and for minors, Public Health and Parasitology.

Mr. S. W. Foster, a member of this Association, who for the past six years has been engaged in Deciduous Fruit Insect Investigations for the United States Bureau of Entomology, is now engaged in the Insecticide Business on the Pacific Coast as Entomologist and Manager of the Insecticide Department of the General Chemical Company of California at San Francisco. Mr. Foster will also be engaged in Research and Special Service Work as regards insect pests of orchard and truck crops.

Prof. S. J. Hunter of the University of Kansas read a paper on "Pellagra and the Sand-fly" before the Second Triennial Meeting of the National Association for the Study of Pellagra, at Columbia, S. C., on October 3. This was a presentation of the results of experiments in the transfusion of blood from Pellagrins to monkeys, and innoculations by means of Sand-flies from Pellagrins to monkeys. Mr. W. T. Emery, a graduate student, is his associate in this work. Thus far no conclusive evidence has been found to associate the Sand-fly with this disease.

In the September number (Vol. I, No. 10) of the *Monthly Bulletin* of the California State Commission of Horticulture, there is published a Host Index to California Coccidæ, by C. F. Baker and E. O. Essig, and a list of the Noctuidæ of the state, as the second installment of the Check List of California Insects, by Prof. C. W. Woodworth. The first installment appeared in the June number (No. 7) of the same volume of the *Bulletin*.

It is reported that the Park Commissioner of New York City has decided to establish in the Swedish schoolhouse, Central Park, a school of entomology, where nature lovers of all ages may learn about the different orders of insects. The Entomologist of the park department, Dr. E. B. Southwick, will have charge of this school.

Dr. E. W. Berger, Entomologist, University of Florida, has recently been awarded a silver medal and a certificate of honor by the Royal Horticultural Society of London, England, for an exhibit of fungus parasites of scales and white-flies in Florida.

Mr. James Walker McColloch, a graduate of Kansas State Agricultural College, who for the past two years has been a special agent for the department of entomology of the Kansas State Agricultural Experiment Station, has been appointed Assistant Entomologist of the Kansas State Agricultural Experiment Station.

Dr. M. C. Tanquary, who for the past three years has been Assistant Entomologist under Doctor Forbes of Illinois and who received his doctor's degree this summer from Illinois University, has been appointed Instructor in Entomology in the Kansas State Agricultural College and Assistant Entomologist of the Kansas State Agricultural Experiment Station.

Prof. George A. Dean, Associate Professor of Entomology in the Kansas State Agricultural College and Associate Entomologist of the Kansas State Agricultural Experiment Station, is now State Entomologist for the northern half of Kansas, is Acting Entomologist for the Kansas State Agricultural Experiment Station and Acting head of the Department of Entomology in the Kansas State Agricultural College.

Herbert T. Osborn of the U. S. Bureau of Entomology, who has been stationed at Salt Lake City on investigations of the alfalfa weevil, has been granted a leave of absence for six months, and will devote the time to graduate work at Ohio State University.

On account of a considerable demand for a course in beekeeping, Prof. J. G. Sanders, Entomologist, will offer such a course in the Wisconsin College of Agriculture during the second semester. Wisconsin was the first to appoint a State apiary inspector, Mr. N. E. France, who has served continuously during the past fifteen years. An effort will be made to amend the present laws and obtain an increased appropriation during the coming winter.

A bill will probably be introduced into the next Legislature of Missouri, providing for the inspection of nurseries and orchards and for extension work in entomology and horticulture. Heretofore there has been no legislation covering these points,

though the Station of its own accord has done considerable work. It is the desire of those having charge of such work at the College and Station at Columbia, Mo., to have the new laws adequately cover the situation containing the good features of similar laws in other states, and suggestions to that effect will be welcomed.

A reorganization has been effected in the Maryland College Station and the State Horticultural Department in charge of Prof. T. B. Symons, by which C. P. Smith, botany, J. F. Monroe, vegetable culture, L. L. Burrell, small fruits, and B. W. Anspon, floriculture and landscape gardening, have been added to the staff for teaching and for extension and demonstration work. The inspection and other field work will hereafter be done by men who have received a broader and more thorough training than has been the case in the past.

The New York State Collections of Insects have been removed to the recently completed and magnificent State Education Building, a thoroughly modern fireproof structure. This gives the State Entomologist enlarged quarters and much better facilities, there being an approximate trebling of both office and exhibition areas.

Mr. C. L. Marlatt, Assistant Chief Entomologist of the United States Department of Agriculture, recently visited the Hawaiian Islands, where he remained about a month arranging for an inspection service in connection with the quarantine recently established on account of the Mediterranean fruit fly. He is now in Washington but is planning to visit California during the winter.

Mr. A. J. Cook, state commissioner of horticulture, of California, has issued a quarantine order, under the approval of Acting Governor A. J. Wallace, against all vegetables, nursery stock, scions, grafts, buds, cuttings, orange seeds, trees, vines, plants and shrubs of all kinds from the states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas and other sections known to be affected with *Aleyrodes citri* (Citrus white fly) or *Aleyrodes nubifera* (another species of white fly.)

Early in September the Governor of Kansas called upon Chancellor Strong of the University of Kansas, to appoint a research commission to investigate the cause of the plague among horses then prevalent in the western half of the state. Prof. S. J. Hunter, entomologist, was placed in charge and associated with him were Dr. W. K. Trimble, pathologist, Dr. A. L. Skoog, neurologist, Prof. N. P. Sherwood, bacteriologist. A complete laboratory was established at Ness City, for experimentation and post mortem studies. The cause of the disease was found to lie in the forage, and is apparently associated with moulds and parasitic fungi. This disease is known in veterinary literature as "Forage Poisoning." A botanical survey of this region by Mr. O. T. Wilson, of the Department of Botany has just been instituted, to determine if possible the specific toxin.

A convention of the Mosquito Extermination Commissioners of New Jersey was held at Newark, October 23. A law passed at the last session of the legislature provided for a commission of six members in each county, and there are twelve such county commissions in New Jersey. All work is subject to the approval of the Director of the Agricultural Experiment Station, who is also charged with carrying out the provisions of the state law providing for the drainage of salt marshes. At the meeting addresses were made by Dr. Jacob G. Lipman, Director of the Station, Dr. T. J. Headlee, State Entomologist and Dr. L. O. Howard, Chief of the Bureau of Entomology at Washington.

At the meeting before the Federal Horticultural Board at Washington, D. C., on October 30, in relation to establishing a quarantine against the Gypsy and Brown-tail Moths, the following officials were present, representing their respective states: J. P. Buckley, Commissioner of Agriculture, Maine; Prof. W. C. O'Kane, State Nursery Inspector, New Hampshire; Dr. H. T. Fernald, State Nursery Inspector and F. W. Rane, State Forester, Massachusetts; A. E. Stene, State Nursery Inspector, Rhode Island; Dr. W. E. Britton, State Entomologist, Connecticut; Mr. G. G. Atwood, in charge of nursery inspection, and Mr. C. R. Pettis, State Superintendent of Forests, New York. Dr. L. O. Howard and Mr. D. M. Rogers of the Bureau of Entomology spoke briefly at the hearing and Assistant Secretary of Agriculture W. M. Hays was present. There was a good attendance of nurserymen from Massachusetts, Rhode Island and Connecticut, several of whom gave their views to the board.

Mr. Frederick Blanchard, a Coleopterist of note, died at his home in Tyngsboro, Mass., November 2, at the age of 69 years. For many years Mr. Blanchard was cashier of the Prescott National Bank of Lowell. He leaves a widow and one brother. Mr. Blanchard was always ready to identify the captures of amateur collectors in the order Coleoptera and will be greatly missed.

There are over 1,000 beekeepers in the State of Tennessee and an attempt will be made to obtain from the next legislature a larger appropriation for inspection of apiaries. On account of insufficient funds for the two years since the law went into effect, this work has been limited. Prof. G. M. Bentley, State Entomologist, has charge of the inspection work.

The public address of the Cleveland meeting of the Entomological Society of America will be given by Dr. Philip P. Calvert of the University of Pennsylvania, on Wednesday evening, January 1, at 8.00 p. m. His subject will be: An Entomologist in Costa Rica. He will give an account of a year spent in this entomologically very rich country, primarily for the study of the seasonal distribution, life-history and habits of Odonata, but including references to other groups of insects, characteristics of various collecting grounds and topics of general interest. It will be illustrated by lantern slides.

The following note will undoubtedly be of interest to many entomologists:

Mr. C. E. Hood carried a policy in an Accident Insurance Company at the time of his death in a motorcycle accident at Urbana, Illinois. The Company has refused to make settlement with the beneficiary, who has been compelled to bring suit. The plea made by the Company is that the policy was issued to Mr. Hood under Class A (preferred), and that it should have been under Class D (hazardous), "as the work of an entomologist is very hazardous." The application executed by Mr. Hood referred to his duties as "Agent and Expert, U. S. Department of Agriculture." It will be news to entomologists that their occupation is considered hazardous and the outcome of the suit will be watched with interest.

Mailed Dec. 16, 1912.

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